SounderSuite - SBP

Software User Manual

Complete Reference

D101-05517
Revision 1.0
November 19, 2012

Knudsen Engineering Limited
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Perth, Ontario, Canada

SOFTWARE INSTALLATION AND FIRMWARE UPGRADE

D101-04383-Rev2.2

ECHOCONTROL SERVER

D101-04381-Rev2.0

ECHOCONTROL CLIENT

D101-05429-Rev1.0

POSTSURVEY

D101-03175-Rev4.0

FIRMWARE LOADER

D101-04382-Rev2.0

CONVERSION UTILITY

D101-04968-Rev1.1

FILE SPECIFICATION: KEL E0 KEB

D101-05498-Rev1.0

FILE SPECIFICATION: SEG-Y

D101-03021-Rev2.2

FILE SPECIFICATION: XTF

D101-03322-Rev2.2

ECHOSOUNDER CONCEPTS

D101-02251-Rev4.1

Formatted for AVERY Ready Index Tbl. Cont. 12 tab

SounderSuite - USB

Windows Installation and Firmware Upgrades

Supports Software Installer Package #: D429-04216

D101-04383
Revision 2.2
December 22, 2010

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CONTENTS

1 INTRODUCTION. 1-1
1.1 About this manual. 1-1
1.2 Technical Support. 1-1

2 SOFTWARE DEFINITIONS. 2-1
2.1 Overview. 2-1
2.1.1 Firmware. 2-1
2.1.2 Windows Support Applications. 2-1
2.1.2.1 EchoControl Server (EchoControlServer.exe). 2-1
2.1.2.2 EchoControl Client (EchoControlClient.exe). 2-1
2.1.2.3 PostSurvey (PostSurvey.exe). 2-1
2.1.2.4 Hypack Device Driver (EchoHypackDLL.dll). 2-1
2.1.2.5 Firmware Loader (FirmwareLoader.exe). 2-1

3 INSTALLATION / UPGRADE GUIDELINES. 3-1
3.1 Initial Installation. 3-1
3.2 System Upgrades. 3-1

4 PC SOFTWARE INSTALLATION. 4-1
4.1 Setup Procedure. 4-1
4.1.1 Special Notes regarding Windows 2000/XP/Vista/7. 4-5
4.2 Driver Installation for Single-Channel Modules. 4-5
4.2.1 Recommended Installation. 4-5
4.2.2 Advanced Installation. 4-8

5 FIRMWARE INSTALLATION. 5-1
5.1 Upgrading the Firmware. 5-1

1 INTRODUCTION

1.1 About this manual

This manual provides installation and upgrade details for the software package provided with a 1600 or 3200 Series Echosounder. It provides brief descriptions of the Windows software applications and the embedded firmware. It explains what needs to be installed for a newly delivered system and what needs to be done to upgrade an existing system.

1.2 Technical Support

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2 SOFTWARE DEFINITIONS

2.1 Overview

Virtually every aspect of the USB Echosounder's functionality is defined and controlled by software. This software includes the "firmware" which resides in non-volatile memories within the echosounder itself, and various Windows-compatible support applications which run on the host PC.

2.1.1 Firmware

The term firmware refers to the software which resides in nonvolatile memory within the Echosounder modules. Upgrades and revisions are distributed periodically as ".bin" files which can be re-programmed into the echosounder module in the field by the user.

2.1.2 Windows Support Applications

There are various Windows applications provided with the USB Echosounders for different support purposes. All the programs are Windows compatible, and are installed with a standard Setup.exe process.

2.1.2.1 EchoControl Server (EchoControlServer.exe)

This program is an independent Windows application that interfaces to the Echosounder via a USB interface. The USB interface must be connected and functioning for this application to be usable. It provides the interconnection between the echosounder hardware on the host PC to the client application on the same PC or another one on the same network. It also provides the interfaces for the peripheral device inputs. This application must be active on the host PC for the client application to communicate properly with the echosounder hardware.

2.1.2.2 EchoControl Client (EchoControlClient.exe)

This program is an independent Windows application that interfaces to the server application via TCP/IP network communications. The server application must be running and successfully connected to the sounder for this application to be usable. It provides scrolling echogram image displays with echosounder operating controls, and controls for data logging and recording functions.

2.1.2.3 PostSurvey (PostSurvey.exe)

This program is an independent Windows application that provides the user playback and printing capabilities for the echogram data recorded by the EchoControlClient application.

2.1.2.4 Hypack Device Driver (EchoHypackDLL.dll)

This program is provided as a device driver to Coastal Oceanographics HYPACK for Windows hydrographic survey software, in the DLL (Dynamic Link Library) format required by HYPACK. This program is only useful to HYPACK for Windows users. It uses DDE data transfer protocol to interface with the EchoControlClient application.

2.1.2.5 Firmware Loader (FirmwareLoader.exe)

This program is a very simple Windows interface program. It communicates with the echosounder through the USB port on the server host PC. It provides simple firmware upgrade capabilities.

3 INSTALLATION / UPGRADE GUIDELINES

3.1 Initial Installation

A newly delivered echosounder has the necessary firmware already programmed into it. The user only needs to load the Windows support applications supplied on the CD-ROM. The CD-ROM contains a Setup.exe Windows installation program that creates the directory and copies all the files onto the user's hard disk. See Chapter 4 for a complete description of the installation process.

3.2 System Upgrades

Occasionally, a system that has already been operating out in the field will be provided an upgrade software package to provide additional operating features not available with the original software. If the Echosounder's firmware is not at the proper revision, it will need to be upgraded. See Chapters 4 and 5 for detailed descriptions of the installation processes.

NOTE: When performing the upgrade, always perform the Windows upgrade first, as this will extract the necessary ".bin" file onto the hard disk required to proceed with the firmware upgrade.

4 PC SOFTWARE INSTALLATION

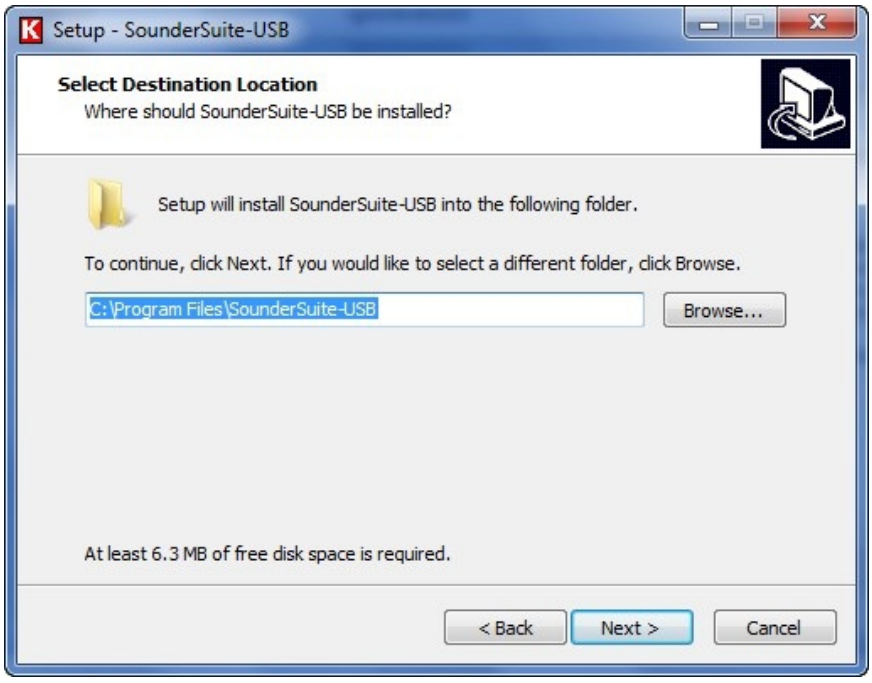
4.1 Setup Procedure

The CD-ROM provided either with a new system or in an upgrade package contains a typical Windows Setup (SounderSetup.exe) installation program. For most Windows systems, this Setup executable will automatically run (autorun) when the CD-ROM is loaded in the drive. If it does not start automatically, simply run the file SounderSetup.exe.

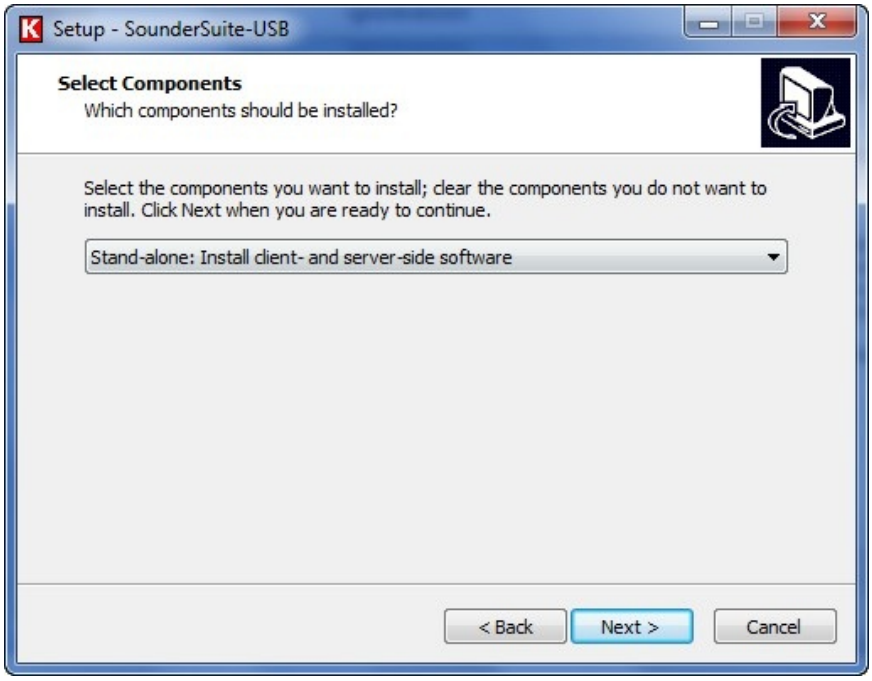
Sometimes the upgrade package is provided by an e-mail or weblink download. In that case, the installer package filename will incorporate the release serial number: ie K206-0110-USB.exe. This is still a standard Windows executable and can be run the same as a Setup.exe file.

When the installer program is run, it displays a number of information and configuration prompts to allow the user to customize the installation process if desired. Customization of the installation should be undertaken by advanced users only. The normal installation process proceeds as follows:

Welcome to the SounderSuite-USB Setup Wizard: Simply click Next to continue.



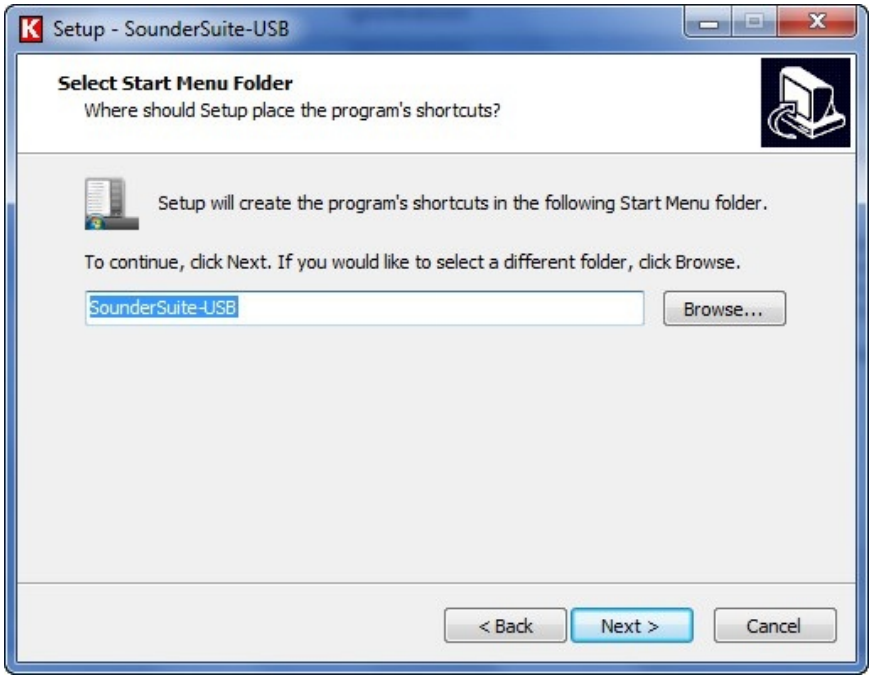
Select Destination Location: Default: C:\Program Files\SounderSuite-USB
If there are any batch files for managing multiple configurations, they will be hardcoded to this folder for now. It is recommended that only advanced users modify this option.



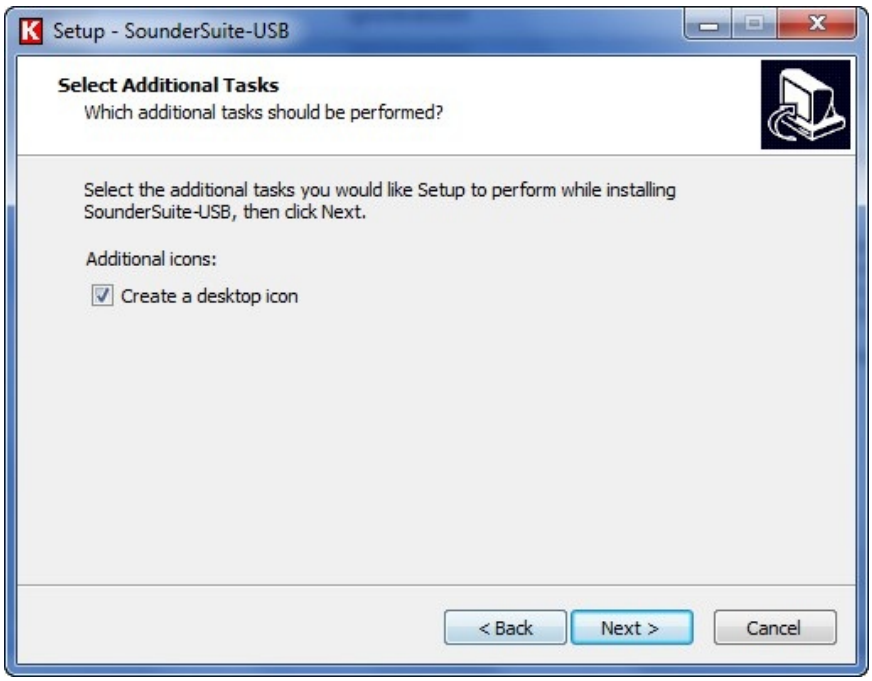
Setup Components: Default: Stand-alone
There are three options available for this item. The required installation depends on the usage of the sounder. The simplest is to load the recommend default **Stand-alone** and run the sounder from the same PC it is connected to (host PC). It is

possible to connect the sounder to one PC and control it from another. That's where the **Server-side** (PC connected to the sounder) and **Client-side** (another computer on the network) can be used. They only load the application components required for each side of the operations.

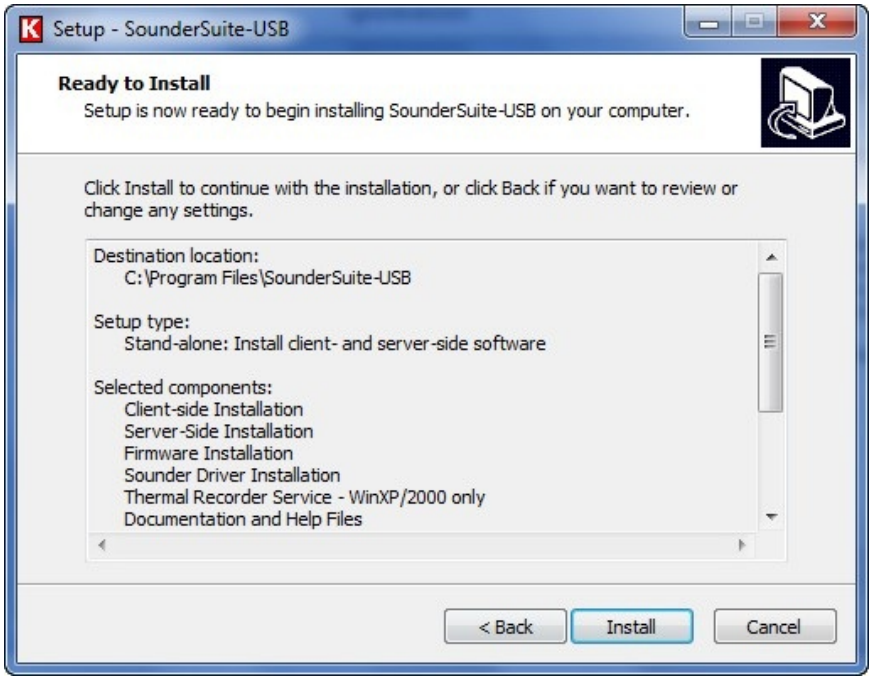
For now, this document assumes that the echosounder is controlled from the same PC to which it is connect (**Stand-alone**).



Select Start Menu Folder: Default: SounderSuite-USB
This can be modified to any preferred value. Please note that all the following documentation assumes that the defaults have been used.



Select Additional Tasks: Default: Desktop Icons
This can be modified to any preferred value. Please note that all the following documentation assumes that the defaults have been used.



Ready to Install: Last chance to cancel before actual installation is performed. Click Next to proceed with the installation. The installer will proceed to copy the application executables, driver setups, firmware files, and support documentation in PDF format. After completing these tasks, a final screen will appear indicating if the setup completed successfully.

If the installation process is being performed for a new unit, the process is now complete. The sounder will have been shipped with the appropriate firmware revisions. If this is an upgrade package, the firmware in the sounder will probably need to be upgraded as well. Please see Chapter 5 for detailed information regarding the firmware upgrade.

Once the installer has completed and restarted, you should see a series of new icons on the desktop. These icons are also available in the Program Group accessible from the Start button.

4.1.1 Special Notes regarding Windows 2000/XP/Vista/7

Because the installer package needs to install driver services and class components, the installation must be done using an administrative account.

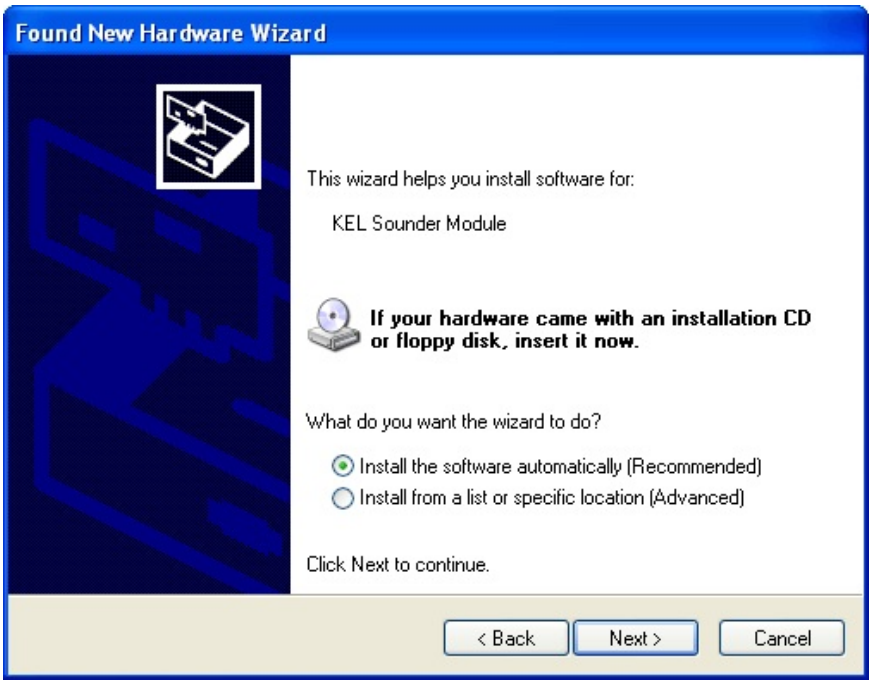
4.2 Driver Installation for Single-Channel Modules

When the Windows software installer was run, it installed all the necessary driver files to support the sounder. In the ideal situation, Windows will automatically recognize the new driver and load the driver by itself when it detects the sounder's internal modules. This is not always the case, though, and the user may need to provide additional direction for Windows to successfully complete the loading of the hardware driver.

4.2.1 Recommended Installation

The first time the sounder is connected and powered on, Windows should indicate that it sees new hardware called a Single-Channel Module and should activate the New Hardware Wizard.

Welcome to the Found New Hardware Wizard: The wizard will ask if it should access the internet to search for the driver for the module. The driver has been loaded on the hard drive so the user should select "**No, not this time**" and click Next.

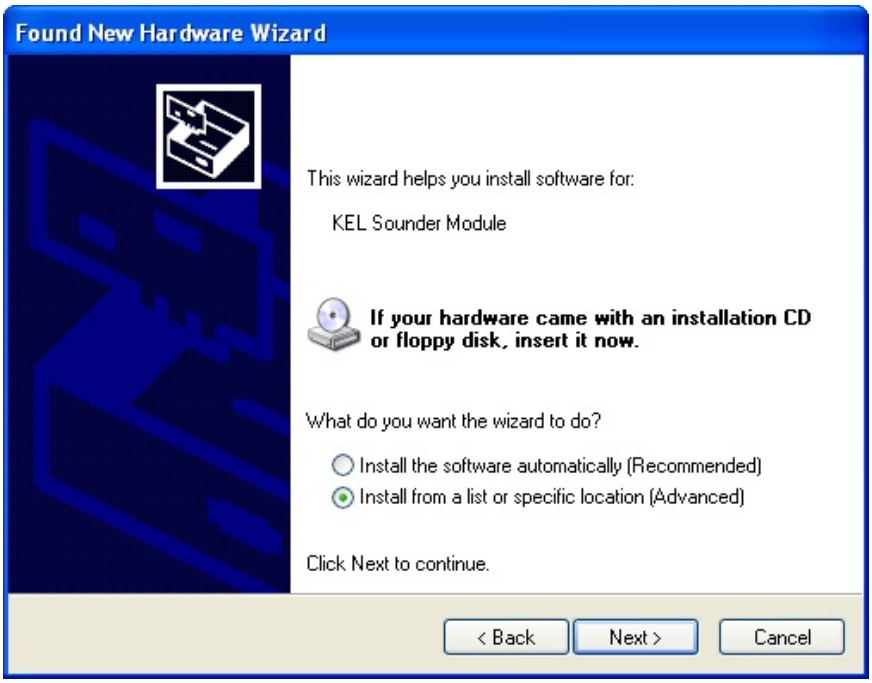


The next dialog asks if the software should be installed automatically (Recommended) or from a list or specific location (Advanced). Normally, the user should be able to select the automatic (Recommended) option, given that the installer application will have already loaded all the necessary files. If it was successful in doing so, the wizard should find the driver files and loaded them without any user assistance.

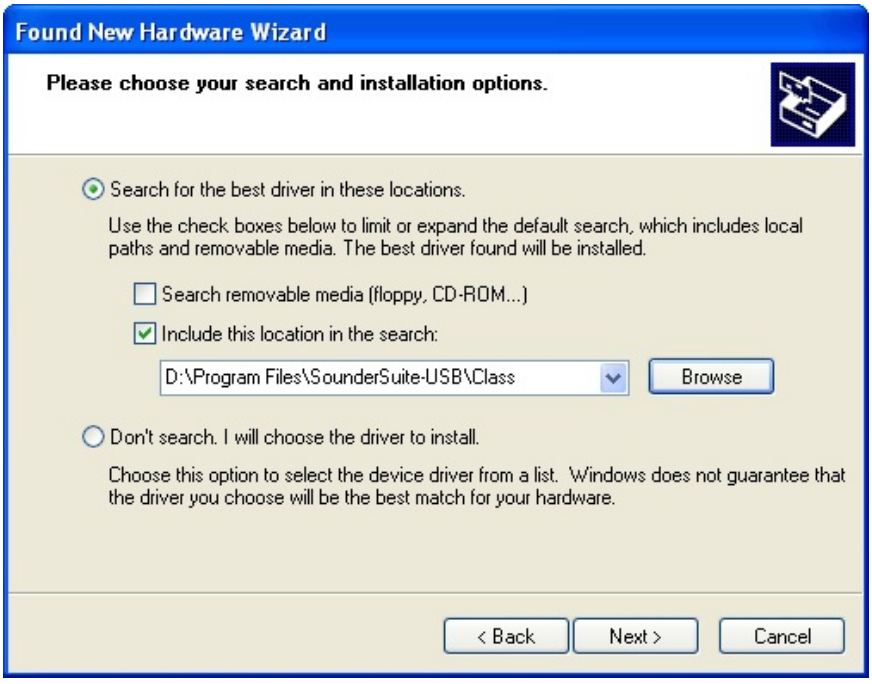
Once it has completed, it will indicate whether or not it was successful in installing the software for the module. If it was the user can simply click on **Finish** to continue. If the sounder has more than one channel, this step needs to be repeated for each

channel module detected in the sounder.

4.2.2 Advanced Installation



Sometimes, the driver file loading performed by the installer application is not successful in indicating to the Windows operating system where the driver files are actually located. In this instance, the user may need to perform an Advanced driver installation instead of the Recommended.



Proceeding with the Advanced installation, the user can browse to the appropriate folder on the hard drive where the

necessary files are stored. In a default installation, this would be the folder C:\Program Files\SounderSuite-USB\Class. As for the Recommended installation, the operating system will load the driver files located in the indicated folder for the module.

Once it has completed, it will indicate whether or not it was successful in installing the software for the module. If it was, the user can simply click on **Finish** to continue. If the sounder has more than one channel, this step needs to be repeated for each channel module detected in the sounder.

5 FIRMWARE INSTALLATION

The firmware installation procedures are only required for system upgrades. Newly delivered systems do not need to have any firmware loaded. Upgrades are performed when new capabilities are added to the echosounder's functionality. Sometimes only the Windows support software is enhanced and firmware remains unaffected. Often the Windows program will indicate if a newer version of firmware needs to be loaded; in other instances, there will be instructions provided with the installation package indicating if an update is required.

A single echosounder may be comprised of a number of hardware channel modules. Upgrading the echosounder involves downloading new firmware into these individual modules. Typically, there will be only one type of module and only one ".bin" file will be required. In those rare cases where there is more than one, a readme file will be included to indicate which .bin is required for which hardware module.

5.1 Upgrading the Firmware

The FirmwareLoader application loaded onto the PC by the installer package provides the interface necessary to upgrade the firmware in the sounder channel modules. The steps to upgrade the hardware modules are as follows:

Step 1. Exit any open SounderSuite windows applications.

Step 2. Power cycle the sounder. The modules will not be able to initiate the firmware loading operation if they have already run a ping cycle.

Step 3. Run the Firmware Loader application available under the Start -> All Programs -> SounderSuite-USB program folder. It should detect the modules in the sounder. If not, it will indicate the appropriate error condition.

Step 4. In Firmware Loader, select **Upgrades -> Load DSP Firmware.** This should cause the application to display a dialog box labelled **Select Sounder Hardware**. The drop down list indicates the modules detected.

Step 5. Select a module to update.

Step 6. The application should now provide a dialog box for opening the firmware file. Ideally, it will already be looking at the appropriate folder; if not, browse to the folder **C:\Program Files\SounderSuite-USB\Firmware**. Select and open the desired .bin file.

Step 7. The application will start the transfer of the firmware to the module. Once it is complete and has passed a validity check, a dialog will appear asking for confirmation that you do want to reprogram the firmware contents in the module. Click on Yes to proceed.

Step 8. The application will display the programming status as it proceeds and indicate once it is completed if it was successful or not.

WARNING: Do NOT turn off the power to the sounder while the programming step is active or the memory in the module could be permanently damaged and require return to the factory for reprogramming.

Step 9. Repeat steps 4-8 for the next module.

The Firmware Loader simply replaces the contents of the on-board boot memory. The new firmware is not actually running

yet. The sounder will need to be rebooted to run the new firmware.

Step 10. Click Close and exit the Firmware Loader application.

Step 11. Power cycle the sounder.

At this point, technically the process is complete but if you wish to verify that the firmware load was completely successful a simple check is in order.

Step 12. Run the Firmware Loader again.

Step 13 Select the **Help** menu option **Sounder Info**. This will bring up a **Module Summary** dialog that shows one tab for each module detected. Listed on this tab is information identifying the module and the firmware detected running in it.

SounderSuite - USB

EchoControlServer

Supports Software: D409-04185

D101-04381
Revision 2.0
July 6, 2009

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CONTENTS

1 INTRODUCTION. 1-1
1.1 About this manual. 1-1
1.2 Technical Support. 1-1

2 OVERVIEW. 2-1
2.1 USB and Network Usage. 2-1
2.2 Description. 2-3
2.3 Taskbar - Restore. 2-4
2.4 Taskbar - About EchoControlServer. 2-4
2.5 Taskbar - Close. 2-4

3 MAIN MENU- System. 3-1
3.1 Scan for Devices. 3-1
3.2 Self-Test. 3-1
3.3 Time Sync. 3-1
3.4 Exit. 3-1

4 MAIN MENU - Recording. 4-1
4.1 Start Line. 4-1
4.2 End Line. 4-1
4.3 Configure. 4-1
4.3.1 File Naming Mode. 4-1
4.3.2 Automatic Numbering. 4-2
4.3.3 Storage Folder. 4-2
4.3.4 File Formats To Be Recorded. 4-2
4.3.4.1 Binary File Format (KEB). 4-2
4.3.4.2 Compress Binary Data. 4-2
4.3.4.3 ASCII File Format. 4-2
4.3.4.4 Modify ASCII output format. 4-3
4.3.4.5 SEG-Y File Format. 4-4
4.3.4.6 SEG-Y Extended Data Fields. 4-4
4.3.4.7 XTF File Format. 4-4

5 MAIN MENU - Hide Window. 5-1

6 MAIN MENU - Clear Log. 6-1

7 MAIN MENU - Help. 7-1
7.1 Sounder Info. 7-1
7.2 Tech Support. 7-2
7.3 About EchoControlServer.... 7-2

1 INTRODUCTION

1.1 About this manual

This manual describes the Windows EchoControl Server application, Part #: D409-04185, EchoControlServer.exe. It is used to connect to the USB Echosounders, providing a central gateway for transfer of sounder controls, peripheral devices, and echogram data to and from various client applications.

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2 OVERVIEW

2.1 USB and Network Usage

The 1600 and 3200 series echosounders were designed with a USB interface port to provide advanced remote control and signal data acquisition and recording capabilities. KEL has developed a pair of specialized PC applications that run under Windows: a client-side application and a server-side application. See Figure 2.0 for reference.

The server-side, EchoControlServer.exe, runs on the host PC (the one physically connected to the sounder) and communicates with the echosounder's internal signal processing modules using the USB interface. It uses TCP/IP communications to receive control settings from the client which it passes to the sounder, and to send echogram data from the sounder to the client. It also interfaces to peripheral devices such as GPS receivers and heave sensors via the host PC's RS-232 ports. It acquires the sensor data and transfers to the client and the sounder as necessary. This document provides details regarding those few operations accessible to the user on the server application.

The client-side application, EchoControlClient.exe can run on either the same host PC as the server-side or on another PC on the same network. This client-side application allows the user to control the echosounder, display in real-time a greyscale graphic on the PC monitor (similar to a hardcopy record), capture envelope signal data, perform standard depth-logging, and record in real-time to a thermal recorder.

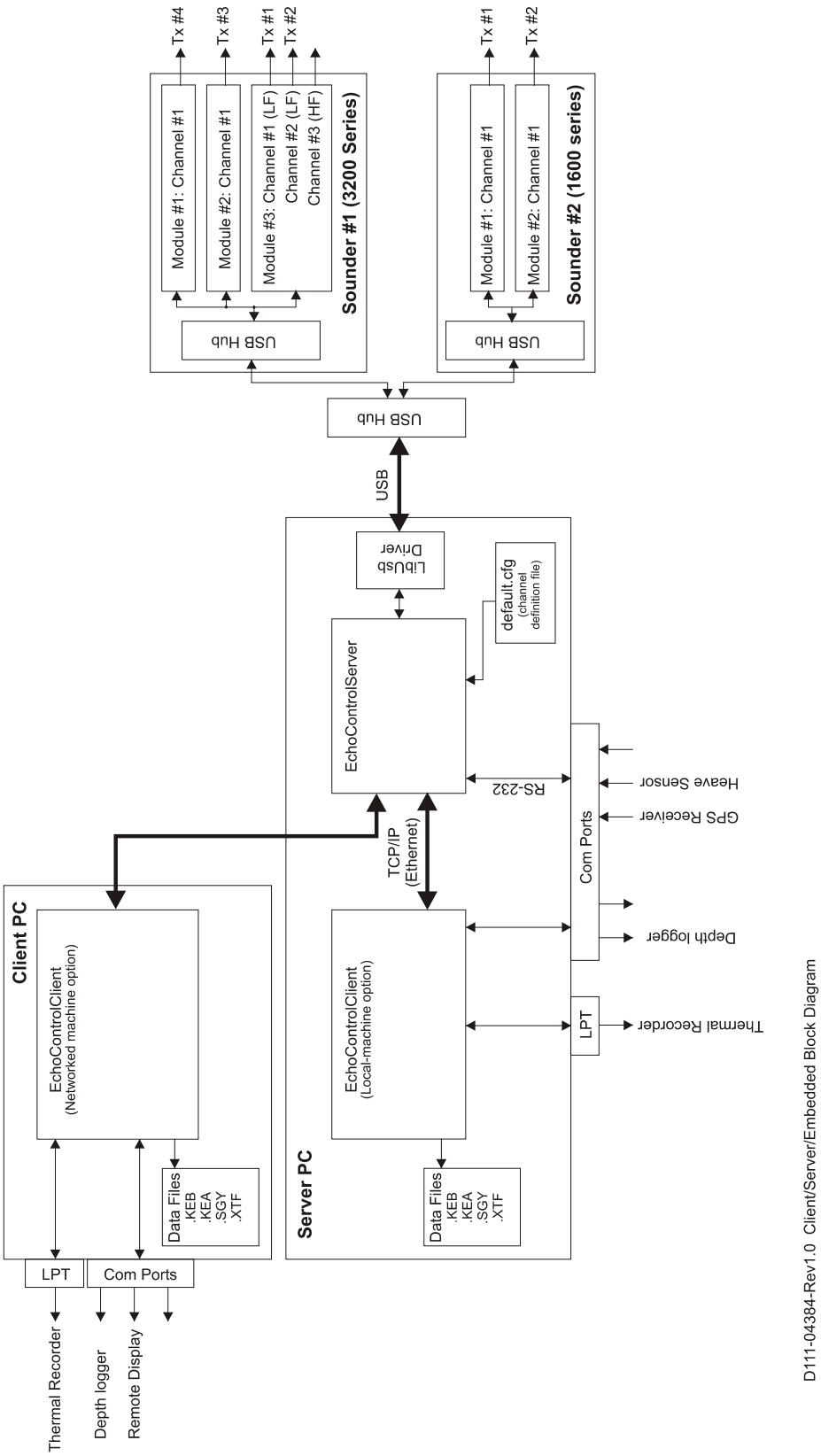
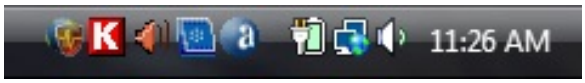


Figure 2.0: Interconnection Block Diagram

2.2 Description

The EchoControlServer application acts as a conduit for control transfer from the client application to the sounder and echogram data from the sounder to the client. It also provides the interface to any serial peripheral devices such as GPS receivers and heave sensors. The server maintains the history of various operational controls, but the adjustment of these controls is available only via a client.

When the program is invoked, if it is successful in detecting one or more DSP channel modules, it will minimize as a small red K in the taskbar.



If an error is encountered the main window will pop up instead of being minimized. This is to allow the user to take corrective actions if possible.

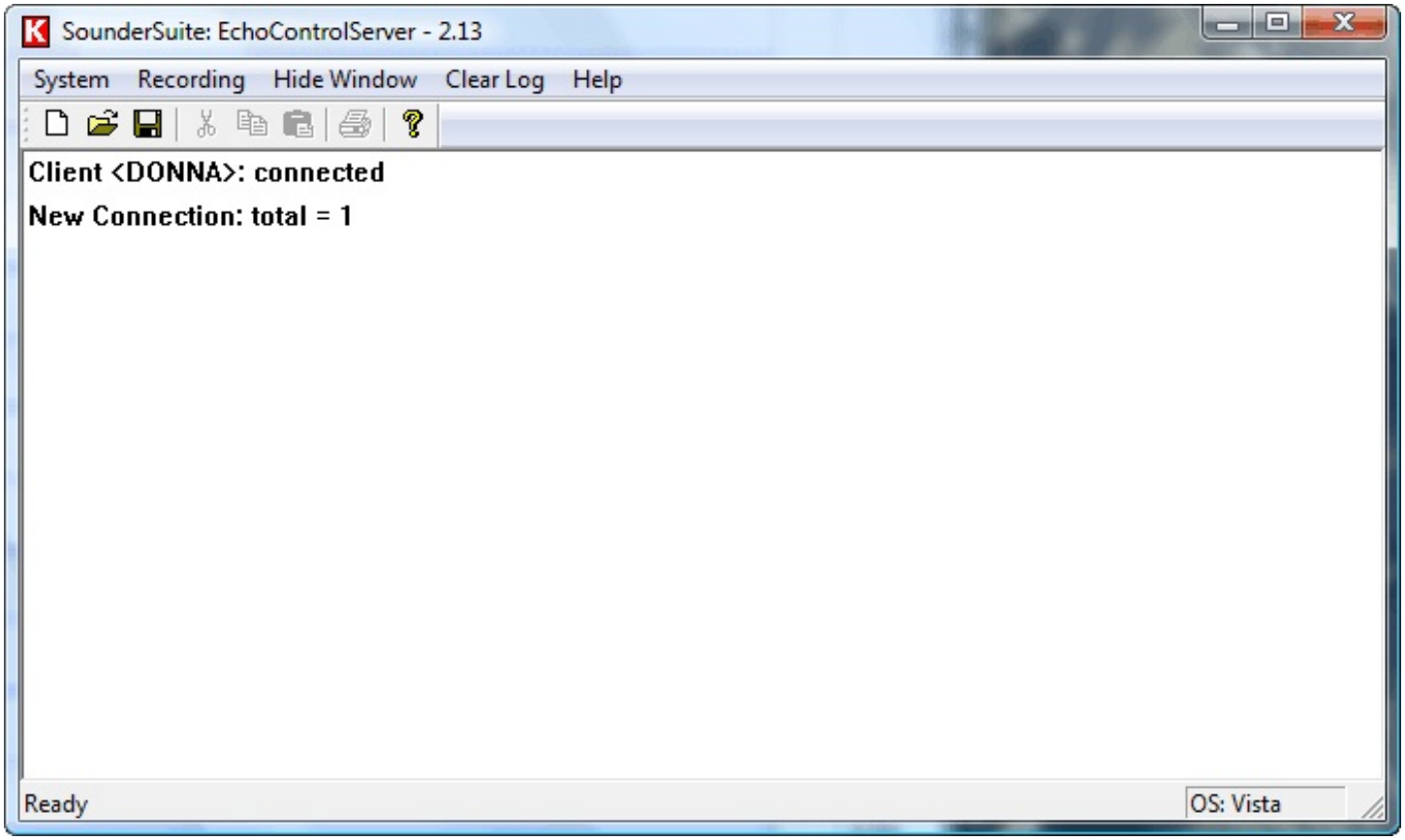


Figure 3.0: Main Application Window

If the user wishes to access the server application window once it has been minimized, they can do so through the icon on the taskbar. A double-click with the left mouse button will Restore the main application window. A single-click with the right mouse button brings up small menu of options including Restore, About EchoControlServer, and Close. When the main window is restored, it pops up with five control groups offered on the main menu bar, and a blank display area used for status

messages regarding client/server interconnections and peripheral input strings.

2.3 Taskbar - Restore

As the name implies, the Restore option on the taskbar icon menu is used to restore the main application window to the desktop.

2.4 Taskbar - About EchoControlServer

This option brings up the About EchoControlServer dialog box. (See Section 7.3)

2.5 Taskbar - Close

The Close option will terminate the server application.

3 MAIN MENU- System

3.1 Scan for Devices

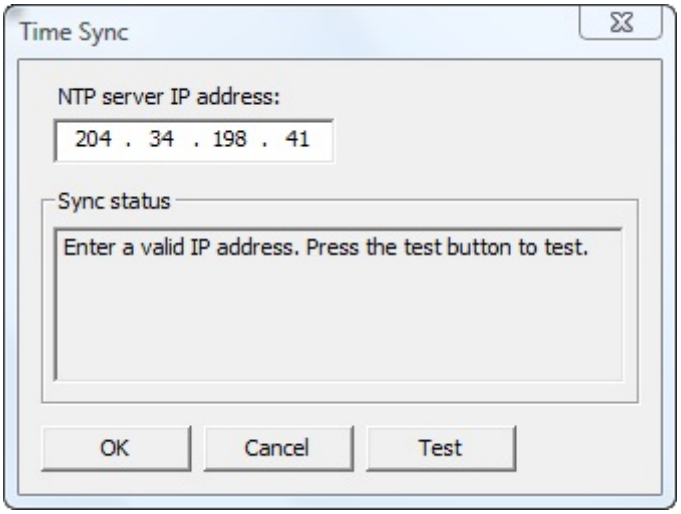
Sometimes on start-up, the EchoControl Server may not see any DSP modules on the bus. This could occur if they are not connected or are powered off. This command gives the user the opportunity to rescan the bus after correcting the source of the problem without having to restart the application. This option is only enabled if no supported modules are detected on the USB bus. If any supported modules are detected, this option is disabled.

3.2 Self-Test

This item is currently not implemented.

3.3 Time Sync

The EchoControl Server application has an NTP client implementation that allows the user to synchronize the PC's time with an external time server, either on the web or a local area network.



The user can enter the IP address of a known NTP server, and click the Test button to initiate a synchronization attempt.

3.4 Exit

The user can terminate the EchoControl Server application using the **Exit** command.

4 MAIN MENU - Recording

This control group allows access to functions that control the recording of data from the echosounder onto the PC drive. All data recording options supported can be active simultaneously.

4.1 Start Line

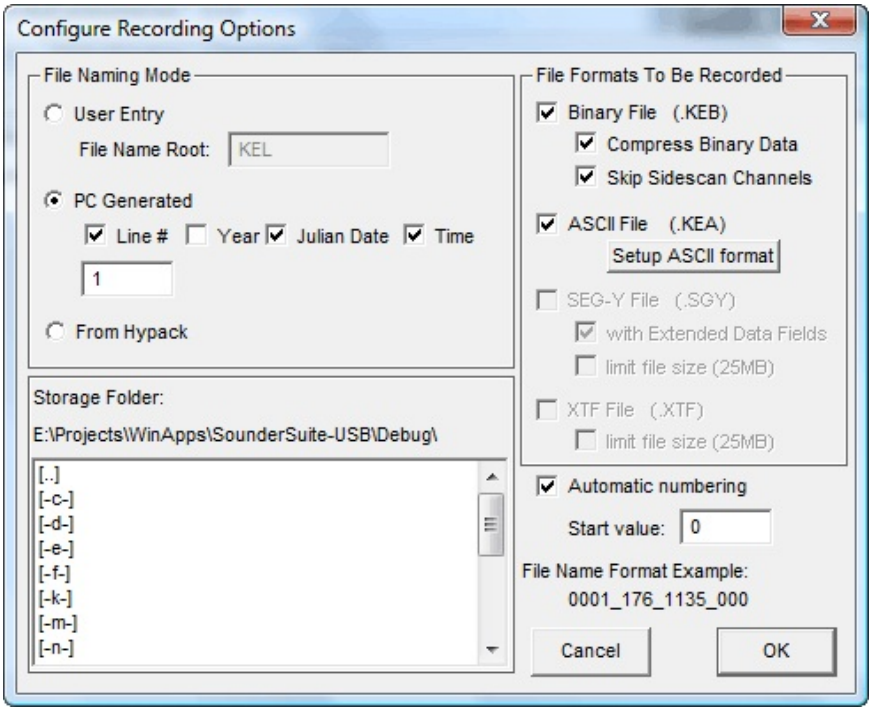
The **Start Line** selection instantly initiates the recording of all the active file formats into the storage folder last selected using the **Configure** option. It is advisable to use **Configure** to verify the setup before initiating the first **Start Line** command.

4.2 End Line

The **End Line** selection causes all data file recording to be terminated and all open data files to be closed.

4.3 Configure

The **Configure** selection pops up a dialog box that allows the user to select the folder (or directory) where the data file set is to be recorded, the filename format used to identify the data set, and the desired output data formats (all can be active at the same time).



4.3.1 File Naming Mode

With the **User Entry** option, the filename is based on the text entered by the user and an automatic numbering scheme. The user must exercise caution in this mode. Because the application will not allow a file to be overwritten that already exists, the user may not be able initiate file recording if the same name is used every time the application is started without ensuring a different Start value for the automatic numbering.

The **PC Generated** format is the most flexible format and the least likely to cause a conflict with identical file names except in the unlikely instance of two **Start Lines** within the same minute. If such a scenario happens frequently, the automatic numbering option will help to prevent duplicate filenames.

From Hypack is only useful if the supporting Hypack DLL is being used to transfer data, file and line info from Hypack Inc.'s Hypack Survey application. This not implemented at this time in the EchoControl Server.

4.3.2 Automatic Numbering

This mode is enabled by default when the **User Entry** filenaming mode is active. Basically, when this mode is active, the filename is automatically appended with a number that starts at the value entered in the **Start value** box and automatically increments every time one recording file is closed and a new one started. Enabling this mode helps to prevent recording problems that occur when a file already exists with a particular file name.

4.3.3 Storage Folder

To modify the **Storage Folder** selection, the user simply double-clicks on the [..] to back up from the current directory, or double-clicks on the new directory or drive name desired. The currently selected folder is displayed in the text line above the selection box.

4.3.4 File Formats To Be Recorded

There are four possible output file formats: Binary, SEG-Y, ASCII and XTF. The SEG-Y format is only available for 3200 series systems using 32-bit processing modules. The XTF and the KEL proprietary formats, KEB and KEA, are always available. Any combination of available formats can be recorded simultaneously.

4.3.4.1 Binary File Format (KEB)

The envelope data for each channel can be recorded in a binary data file for use by post-processing software. Every ping cycle, one record is stored with header information and raw data for each frequency channel. Each record is variable in length, and may be compressed using a Huffman compression algorithm. The storage device for these files should have sufficient disk space free to store the vast amounts of data generated, especially when working in shallow water where the faster ping rate results in a larger volume of data being generated.

See the File Format Specification KEB - D0 Format, Document # D101-04386 for complete formatting details

4.3.4.2 Compress Binary Data

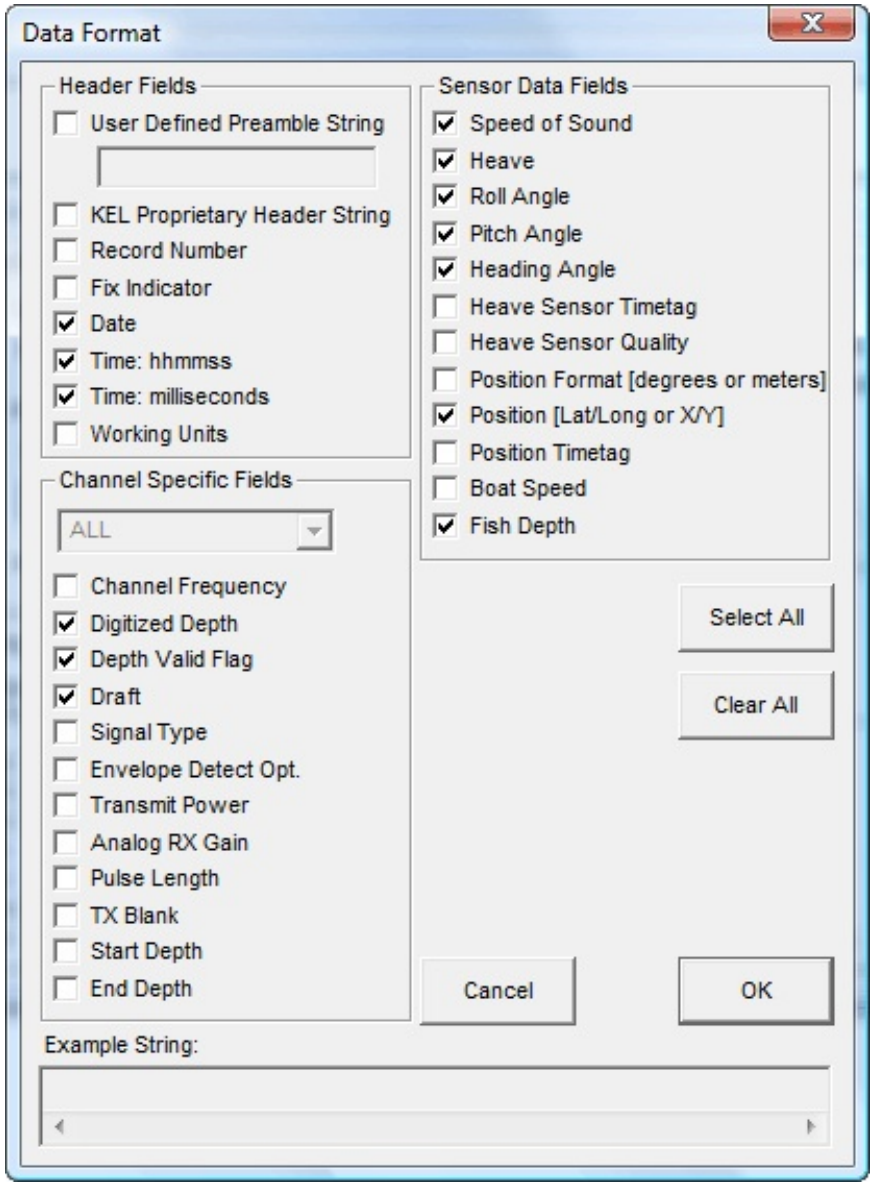
When the **Compress Binary Data** box is checked, the application will compress all the KEB binary data records using a Huffman compression algorithm on each record. The File Type Id Preamble in each data file will indicate that Huffman compression has been applied. This control gives the user the option to store in a compressed or uncompressed format.

4.3.4.3 ASCII File Format

The ASCII output file can be used to log many data fields such as depth, echosounder time, GPS position, and heave. Since these files do not contain any of the raw envelope data, they use substantially less disk space than the binary files. Every ping cycle, the application records one output string.

The user can request to modify the desired output data format by clicking on the **Modify ASCII output format** button. This

causes the application to pop up a configuration dialog box with selection options for the desired data fields.



4.3.4.4 Modify ASCII output format

This dialog box allows the user to customize the ASCII file format string with certain limitations. The fields can only appear in the order listed (ie header string, HF depth, LF depth, checksum) separated only by commas (except hhmmss and milliseconds), and terminated only at the very end by <CR>< LF>.

As various fields are selected or deselected, the **Example String** at the bottom of the dialog box changes to illustrate the expected output format.

Some fields can only be selected if other fields are also selected and will be inactive (greyed out) if the required field is not selected. For example, the Position Latency field is an active option only if the Position field is selected.

The format configuration selected is stored in the application's registry keys and restored the next time the program is invoked.

4.3.4.5 SEG-Y File Format

(not implemented at this time)

The SEG-Y output file format has been defined to meet as accurately as possible the Rev0 format specifications defined by the Society of Exploration Geophysicists.

See the KEL SEGY FORMAT USAGE DEFINITION document, D101-03021, for complete formatting details.

4.3.4.6 SEG-Y Extended Data Fields

(not implemented at this time)

The original SEG-Y specification does not account for many useful data fields. If the user selects the option to include the extended data fields, numerous operation controls are recorded in the unassigned bytes at the end of the Rev0 Trace header. Some SEG-Y readers do not recognize files that contain data in these bytes, so it is advisable to verify the requirements for the desired reader application before selecting this option.

See the KEL SEGY FORMAT USAGE DEFINITION document, D101-03021, for complete formatting details.

4.3.4.7 XTF File Format

(not implemented at this time)

The XTF output file format is a specialized format used to record Sidescan data. The format has been defined to be compatible with the standard as defined by Caris.

See the KEL XTF FORMAT USAGE DEFINITION document, D101-03322 for complete formatting details.

5 MAIN MENU - Hide Window

This menu control simply causes the application to minimize to the taskbar.

6 MAIN MENU - Clear Log

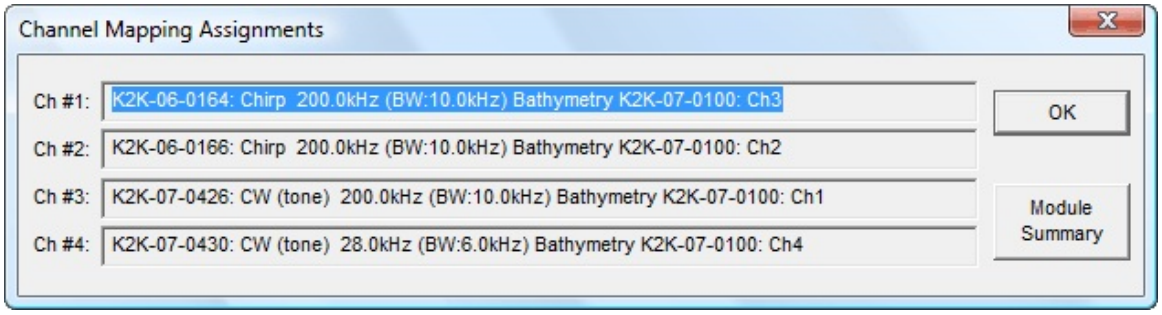
The main window of the EchoControl Server is used to display various feedback messages to the user. These can include information about what clients have been connected or disconnected as well as the strings received from peripheral devices. If the information is getting too confusing, the user can clear the log and start with a fresh display.

7 MAIN MENU - Help

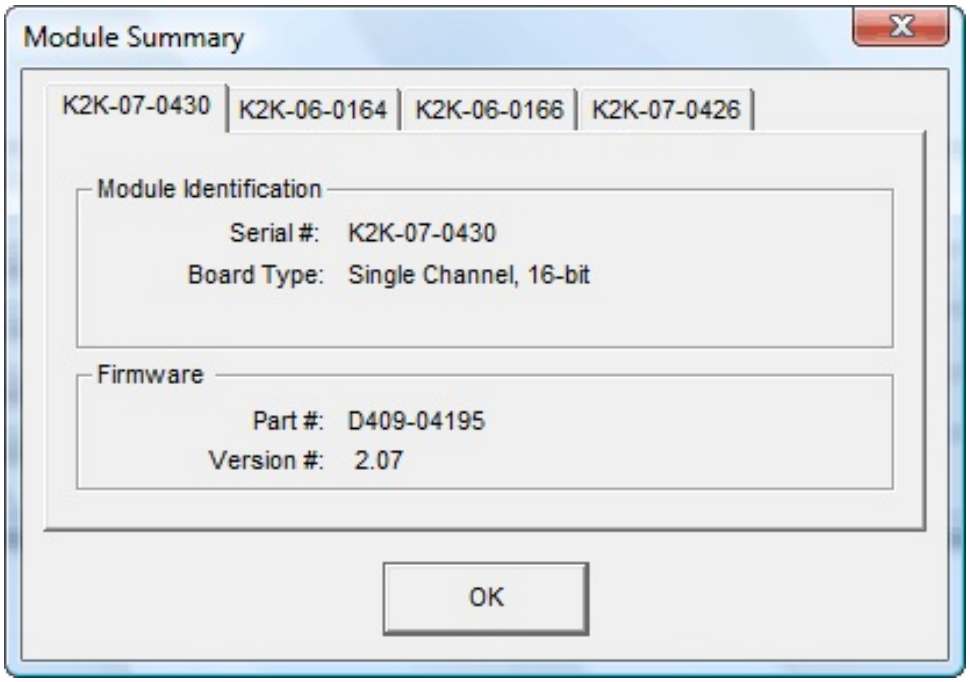
The **Help** menu provides access to system configuration information that is most useful when contacting the factory for technical assistance. There are no other help features implemented at this time.

7.1 Sounder Info

This option pops up the Channel Mapping Assignments dialog box that summarizes assigned usage of the channel modules detected by the server.

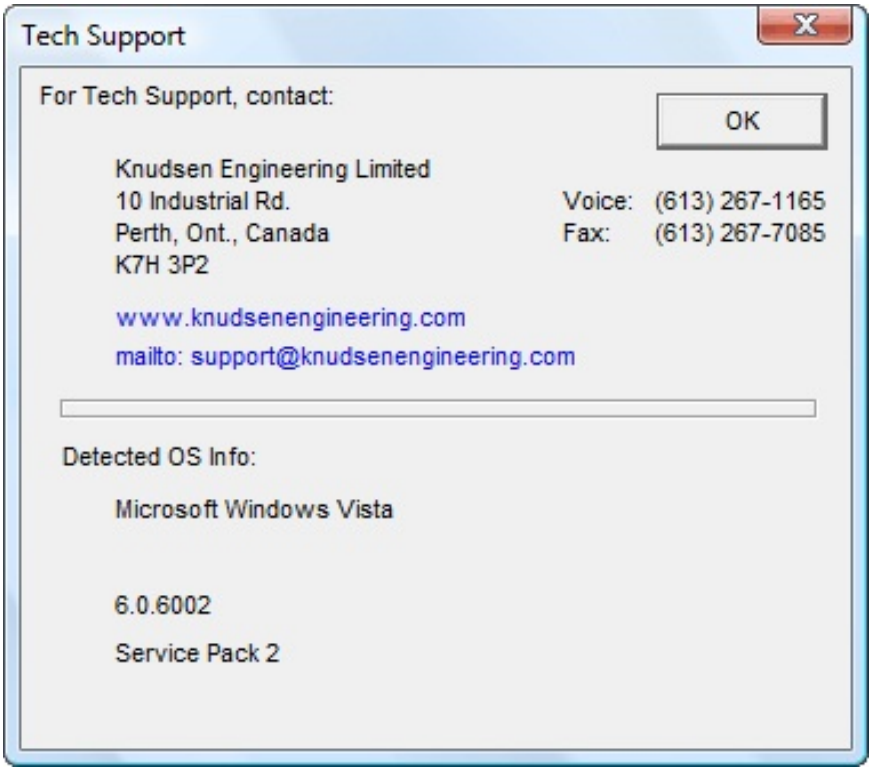


The user can click on the Module Summary button to access the dialog of the same name.



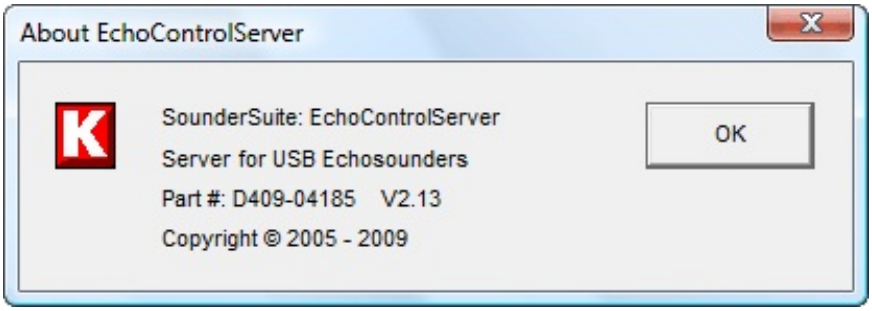
The Module Summary dialog provides information regarding the hardware channels detected in the sounder by the server application. For each hardware module, it reports the programmed serial number, the module's type, and the firmware part number and version. This is a useful reference for verifying the hardware status in the sounder.

7.2 Tech Support



This option brings up a simple dialog box that provides contact information for technical support. It also provides information about the type of Windows operating system the server program has detected.

7.3 About EchoControlServer...



The **About EchoControlServer...** menu item brings up a simple dialog box stating the name of the PC software program, the KEL part number for the program, and the latest revision number.

SounderSuite - SBP Pinger

EchoControl Client

Supports Software: D409-04184

D101-05429
Revision 1.0
April 27, 2012

Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario, Canada

CONTENTS

1 INTRODUCTION. . . . 1-1
1.1 About this manual. . . . 1-1
1.2 Technical Support. . . . 1-1

2 OVERVIEW. . . . 2-1
2.1 USB and Network Usage. . . . 2-1
2.2 Description. . . . 2-3
2.3 Types of Parameters. . . . 2-3
2.4 Types of Controls. . . . 2-4

3 INITIAL START-UP. . . . 3-1
3.1 Server Connection. . . . 3-1
3.2 Startup Options. . . . 3-2
3.3 Full Window Display. . . . 3-2
3.3.1 Status: Enabled/Disabled. . . . 3-3
3.3.2 Contrast. . . . 3-4
3.3.3 Display Mode. . . . 3-4
3.3.4 Colour Mode. . . . 3-4
3.3.5 Embedded Text: Enabled/Disabled. . . . 3-4
3.3.6 Grid Mode. . . . 3-4

4 APPLICATION TOOLBAR. . . . 3-6
4.1 Global Tx. . . . 3-6
4.2 Record Start/Stop. . . . 3-6
4.3 3-6
4.4 Depth Channels. . . . 3-7
4.4.1 Analog Gain: Auto/Manual. . . . 3-8
4.4.2 TVG Mode. . . . 3-8
4.4.3 Gain Slider. . . . 3-9
4.4.4 Tx Pulse. . . . 3-9
4.4.5 Tx Power. . . . 3-9
4.4.6 Digital Gain. . . . 3-9
4.4.7 Tx Blanking. . . . 3-9
4.5 Setup. . . . 3-10
4.5.1 **Configure Recording**. . . . 3-10
4.5.1.1 File Naming Mode. . . . 3-11
4.5.1.2 Automatic Numbering. . . . 3-11
4.5.1.3 Storage Folder. . . . 3-11
4.5.1.4 File Formats To Be Recorded. . . . 3-12
4.5.1.5 Binary File Format (KEB). . . . 3-12
4.5.1.5.1 Compress Binary Data. . . . 3-12
4.5.1.5.2 Skip Sidescan Channels. . . . 3-12
4.5.1.6 ASCII File Format. . . . 3-12
4.5.1.6.1 Setup ASCII format. . . . 3-13
4.5.1.7 SEG-Y File Format. . . . 3-14
4.5.1.7.1 SEG-Y Extended Data Fields. . . . 3-14
4.5.1.7.2 Limit File Size (25MB). . . . 3-14
4.5.1.8 XTF File Format. . . . 3-14

4.5.1.8.1 Limit File Size (25MB). . . . 3-14
4.5.2 Configure Peripherals 3-14
4.5.2.1 Settings. . . . 3-15
4.5.2.1.1 Baud Rate. . . . 3-15
4.5.2.1.2 Parity. . . . 3-15
4.5.2.1.3 Data/Stop bits. . . . 3-16
4.5.2.2 Format. . . . 3-16
4.5.3 Data Logging. . . . 3-16
4.5.3.1 Settings. . . . 3-17
4.5.3.1.1 Baud Rate. . . . 3-17
4.5.3.1.2 Parity. . . . 3-18
4.5.3.1.3 Data/Stop bits. . . . 3-18
4.5.3.1.4 Transmission Rate. . . . 3-18
4.5.3.2 Format. . . . 3-18
4.5.3.2.1 Configurable. . . . 3-19
4.5.4 Configure UDP Broadcast. . . . 3-20
4.6 Advanced Options. . . . 3-21
4.6.1 Signal Controls Page. . . . 3-21
4.6.1.1 Waveform. . . . 3-22
4.6.1.2 Frequency. . . . 3-22
4.6.1.3 Bandwidth. . . . 3-22
4.6.1.4 Start/Stop Frequencies. . . . 3-22
4.6.1.5 Channel Enable. . . . 3-23
4.6.1.6 Draft. . . . 3-23
4.6.1.7 Filter Windowing. . . . 3-23
4.6.1.8 Usage. . . . 3-23
4.6.1.9 Envelope Detect. . . . 3-23
4.6.1.10 Echogram Type. . . . 3-23
4.6.2 System Settings Page. . . . 3-24
4.6.3 Working Units. . . . 3-25
4.6.4 Speed of Sound. . . . 3-25
4.6.5 Ping Rate. . . . 3-26
4.6.6 Tracking Gate. . . . 3-27
4.6.7 Echogram: Heave Compensated/Uncompensated. . . . 3-27
4.6.8 Sync Mode: Internal/External. . . . 3-27
4.7 Setup Sub-Menu. . . . 4-1
4.7.1 Save Configuration. . . . 4-1
4.7.2 Load Configuration. . . . 4-1
4.7.3 Diagnostic Tools. . . . 4-2
4.7.3.1 Analog Output. . . . 4-2
4.7.3.1.1 Test Pulse. . . . 4-2
4.7.3.2 Depth. . . . 4-2
4.7.3.3 Scale. . . . 4-2
4.7.4 Recorder Setup. . . . 4-2
4.7.4.1 Recorder. . . . 4-3
4.7.4.2 Status: Enabled/Disabled. . . . 4-3
4.7.4.3 Contrast. . . . 4-3
4.7.4.4 Mode. . . . 4-3
4.7.4.5 Font Size. . . . 4-3
4.7.4.6 Overlays. . . . 4-4
4.7.5 Oscilloscope. . . . 4-4

4.7.6 Recording Status. 4-6
4.7.7 Setup Event Marks. 4-7
4.7.7.1 Next Event. 4-7
4.7.7.2 Timed Event: Enabled/Disabled. 4-7
4.7.7.3 Event Interval. 4-7
4.7.7.4 Increment/Decrement Event #s. 4-8
4.7.8 Event Annotation. 4-9
4.7.9 Factory Defaults. 4-9
4.7.10 Display/Recording Controls. 4-9
4.7.11 EchoSounder Controls. 4-10
4.7.12 Preferences. 4-10
4.8 Sounder Info. 4-10
4.8.1 Module Summary. 4-11
4.9 Tech Support. 4-11
4.10 About EchoControlClient. 4-12
4.11 Status Bar. 4-13

LIST OF TABLES

LIST OF FIGURES

Figure 2.0: Interconnection Block Diagram.. 2-2
Figure 2.1: Main Application Window. 2-3
Figure 3.0: Startup Options Dialog.. 3-2
Figure 4.0: Application Toolbar. 3-6
Figure 4.1: Depth Channel Dialog showing collapsed and expanded modes. 3-8
Figure 4.2: Setup Sub-Menu. 3-10
Figure 4.5: UDP Message Format Dialog. 3-21
Figure 4.9: Thermal Recorder Setup Dialog. 4-3
Figure 4.10: Overlay Selections Dialog. 4-4
Figure 4.11: Ping Chart Dialog. 4-5

1 INTRODUCTION

1.1 About this manual

This manual describes the client-side Windows application: Part # D409-0XXXX: EchoControlClient.exe. It is used to control operational parameters and to record data from Pinger series USB echosounders. It communicates via TCP/IP with the server-side application (EchoControlServer) that connects to the actual physical sounder.

1.2 Technical Support

For technical support or to report problems please contact your local representative or:

Technical Support
Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario
K7H 3P2

Voice: (613) 267-1165 8:30 am to 5:00 pm E.S.T. Core Hours
Fax: (613) 267-7085
E-Mail: support@knudsenengineering.com
WebSite: http://knudsenengineering.com/

2 OVERVIEW

2.1 USB and Network Usage

The Pinger series echosounders were designed with a USB interface port to provide advanced remote control and signal data acquisition and recording capabilities. KEL has developed a pair of specialized PC applications that run under Windows to interface to these sounders: a client-side application and a server-side application. See Figure 2.0 for reference.

The server-side, EchoControlServer.exe, runs on the host PC (the one physically connected to the sounder) and communicates with the echosounder's internal signal processing modules using the USB interface. It uses TCP/IP communications to receive control settings from the client which it passes to the sounder, and to send echogram data from the sounder to the client. It also interfaces to peripheral devices such as GPS receivers and heave sensors via the host PC's RS-232 ports. It acquires the sensor data and transfers it to the client and the sounder as necessary.

The client-side application, EchoControlClient.exe can run on either the same host PC as the server-side or it can run on another PC on the same network. See Section 3.1 for details on how to connect appropriately. This client-side application allows the user to control the echosounder, display in real-time a greyscale or color graphic on the PC monitor (similar to a hardcopy record), capture envelope signal data, perform standard depth-logging, and record in real-time to a thermal recorder. This document provides details regarding access and control of all these operations.

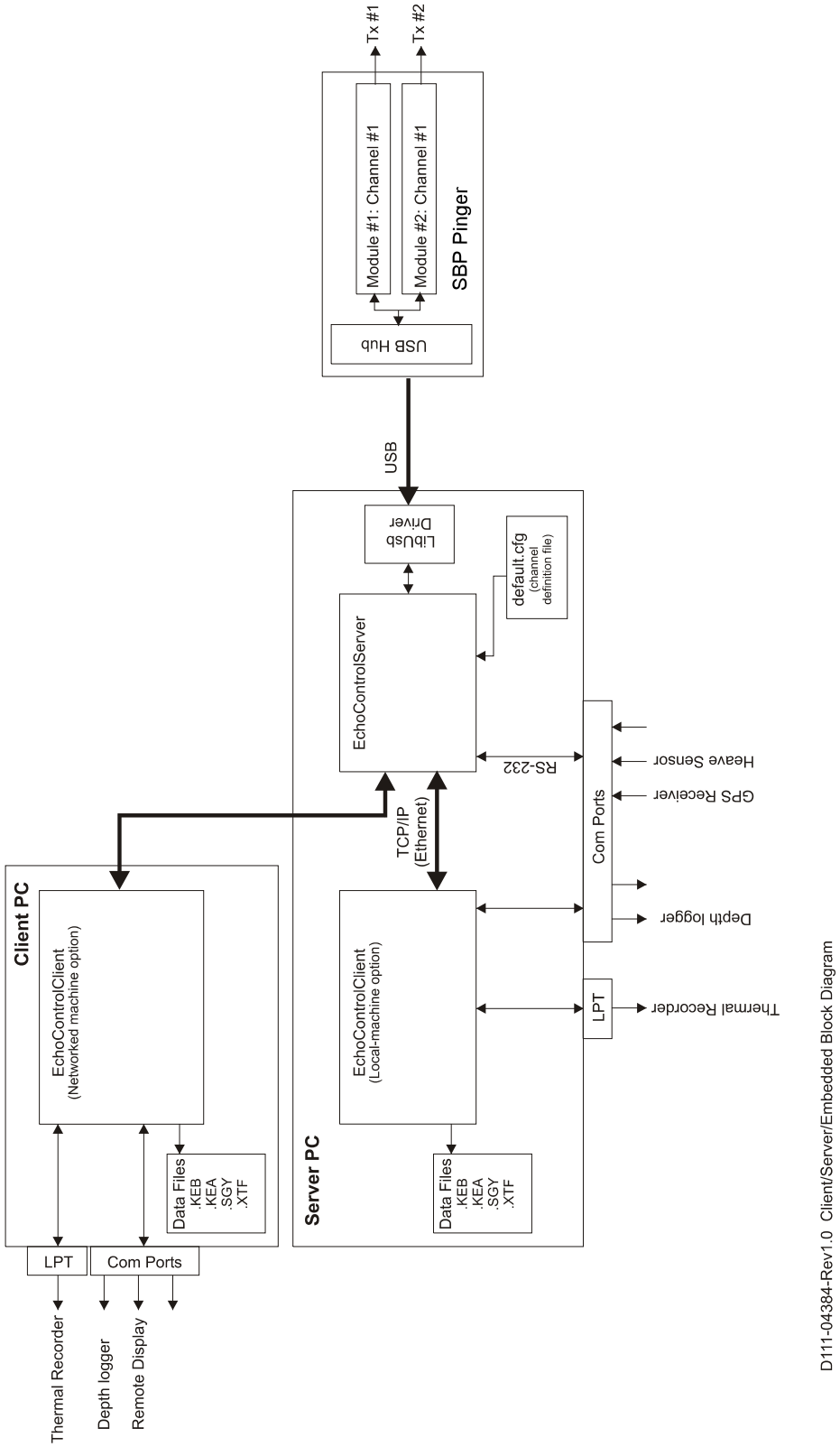


Figure 2.0: Interconnection Block Diagram

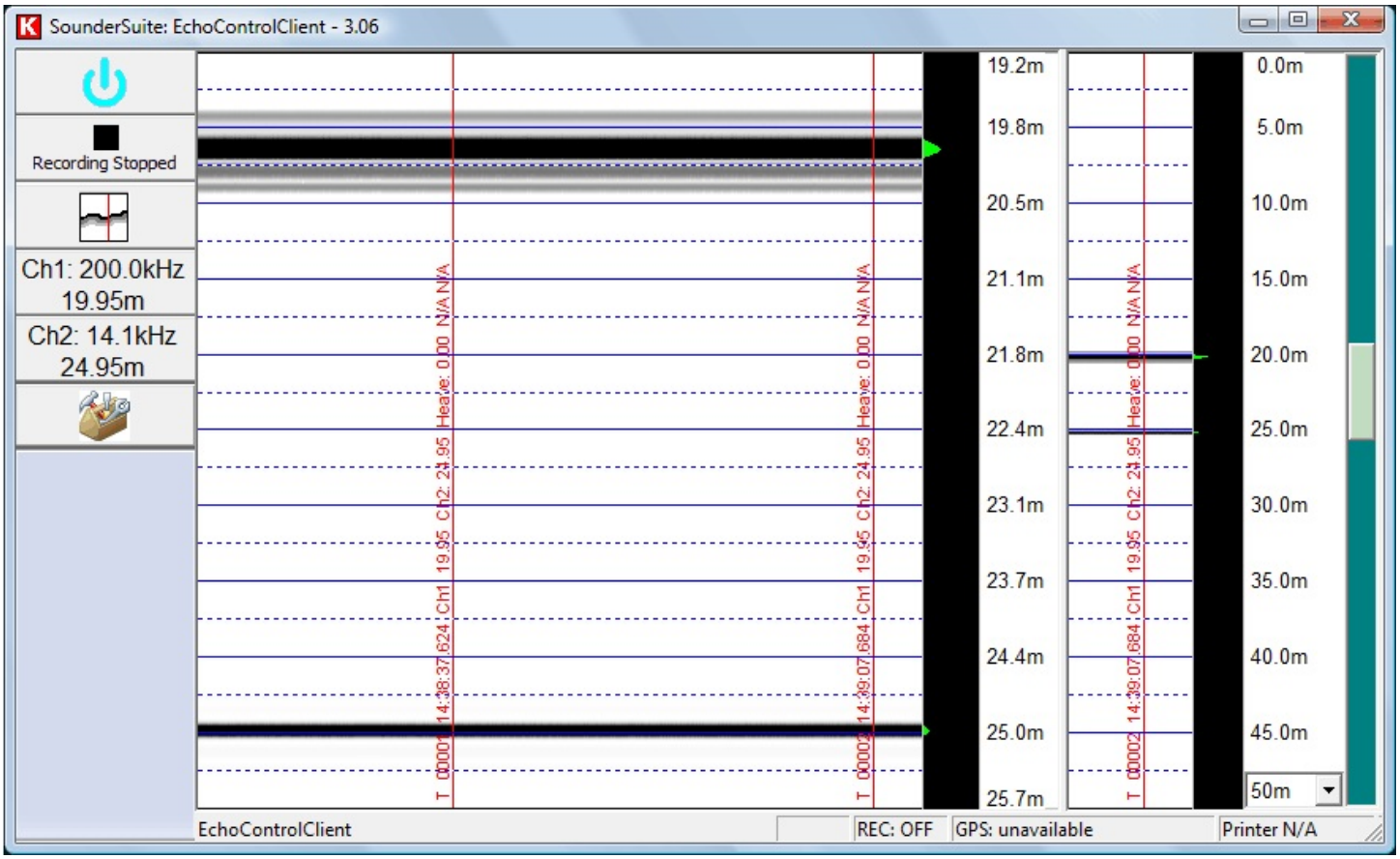


Figure 2.1: Main Application Window

2.2 Description

The EchoControlClient application contains all the necessary controls for standard operation of the echosounder and any data recording activities on the PC. The application main window consists of the application toolbar, the zoom chart display, the full chart display and the zoom window control. The application toolbar provides access to the operational and configuration controls. The full chart display (on the right in Figure 2.1) shows a graphical rendering of the real-time echo data for both channels for the entire acquisition window. The scale of depths is to the right of the display. The maximum acquisition depth is selectable by way of a drop-down list control. To the right of the depth scale is the zoom window control. This control is adjustable in size and position and selects a section of the full window display to be shown in the zoom window display.

2.3 Types of Parameters

Before proceeding with the description of the operational controls, it is worth making the distinction between Echosounder controls and Application controls.

Echosounder parameters: The Echosounder has numerous controls that control its performance and operation. These controls are normally preserved by the server application in order to retain the same settings regardless of which client PC is used to interface the next time the system is started. The server stores the necessary parameters in the registry of the host PC. Examples of Echosounder parameters are *Transmit Pulse Length* and *Maximum Acquisition Depth*.

Application parameters: The EchoControlClient application has a number of controls that affect the presentation and recording of the data received from the echosounder. These controls have no effect on the performance of the echosounder, just the behaviour of the EchoControlClient application itself. Most of these controls are preserved in the Windows registry when the application shuts down. Examples of Application parameters are *Contrast* and *Zoom Window Size*.

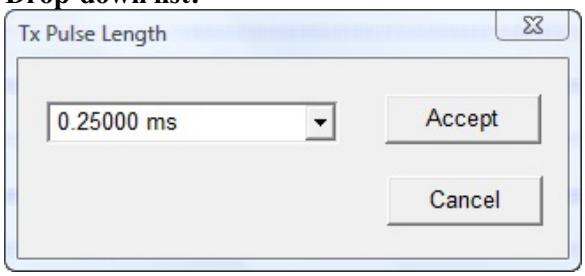
Throughout the following descriptions is a notation indicating if the control parameters being discussed are Echosounder parameters or Application parameters.

2.4 Types of Controls

The majority of the dialogs that are accessed via the menus serve as both status displays and control access. The control status is displayed in the text of a button control. Unless the button control is for a simple state toggle parameter, clicking on the button will bring up one of three possible control dialogs dependent on the control type. For button controls that are simple toggle parameters, clicking the button instantly toggles the state of the parameter; ie on / off control will immediately toggle between the on state and the off state. While the control dialogs that get activated are modal boxes (meaning they have to be closed before you can access other controls), they do apply new settings in real-time. This allows the user the opportunity to try the effect of a parameter change but allows the change to be cancelled if not desirable.

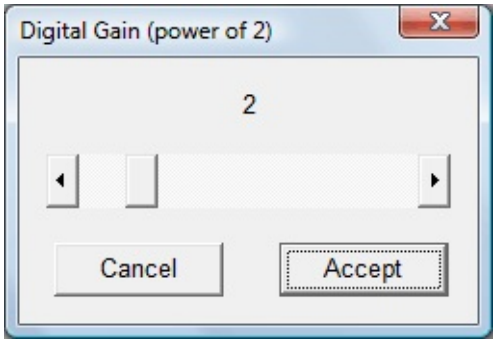
As mentioned, there are three possible control styles that are used for adjusting parameter values. These are the drop-down list control dialog, the scroll bar control dialog, and the keypad control dialog.

Drop-down list:



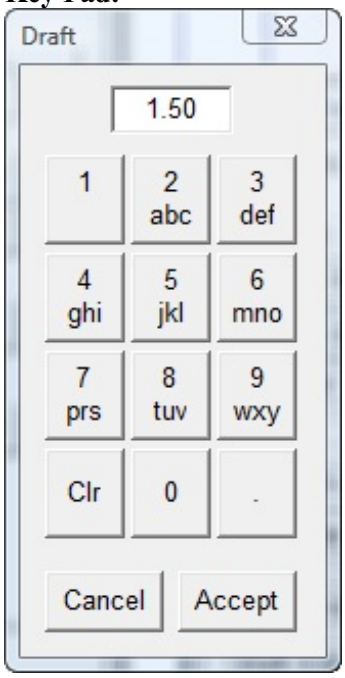
For parameters with a finite list of possible options such as pulse length or transmit power, the drop-down list control will appear. The control will show the currently active value. The user can change the value by clicking on the down arrow beside the current selection which drops down the list of available options and then by clicking on the new selection in the list. If keep the new selection is desired , clicking on **Accept** will apply the change permanently; clicking **Cancel** will abort the change and restore the value initially in use.

Scroll bar adjustment:



Some parameters can have a continuous range of valid values. The scroll bar control allows the user to quickly adjust the parameter within a large range of values. Clicking the arrows will increase / decrease the parameter with the smallest allowable increment/decrement. Clicking and dragging the slider tab adjusts the parameter value very quickly but usually the arrows need to be used to fine-tune the setting. Clicking on the bar between the tab and the end arrows, allows the parameter to be adjusted in larger steps. The size of the steps depends on the range of values and the minimum allowable increment/decrement already assigned. As with the drop-down list, if keeping the new selection is desired, clicking on **Accept** will apply the change permanently; clicking **Cancel** will abort the change and restore the initial value.

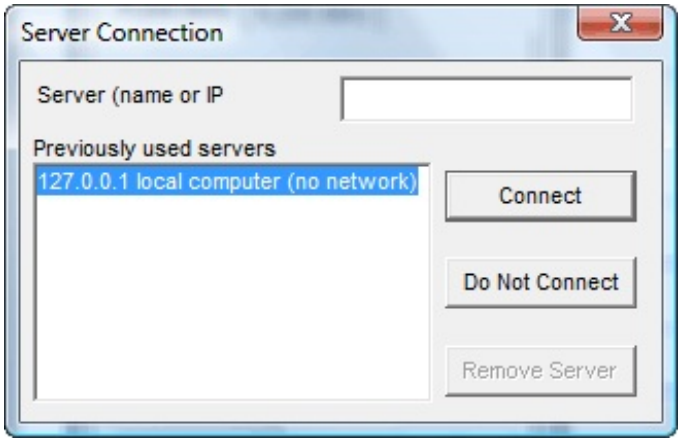
Key Pad:



For more complicated parameters with very large ranges of allowable selections, such as speed of sound or draft, it is often easier to input the desired value directly. Scroll bars work well for small ranges of values but become very difficult to set when the range becomes very large. It is hard to finetune to a specific value because the increments are too sensitive. For these types of parameters, there is the keypad control. This control is a little more complicated than the previous two described. There are additional buttons designed to aid in the setting of the parameter. The **Clr** button is used to clear the current value in anticipation of setting a new value. If an error is made in entering the value, the **Clr** button can be used to restart the entry. Unlike the other two control dialogs, the effects of the parameter change are not immediate. If it is desired to keep the new selection, clicking on **Accept** will apply the change permanently; clicking **Cancel** will abort the change and restore the initial value.

3 INITIAL START-UP

3.1 Server Connection



The first time the EchoControlClient application is started, it will attempt to automatically locate the EchoControlServer application, start the application if necessary and establish a connection. If the client is unable to find the server application, the Server Connection dialog will appear to select its location of the server application (and that of its echosounder). The most common usage is on the local machine, the same host PC as the server application. This configuration can be selected by clicking on the option for "**127.0.0.1 local computer (no network)**" available by default in the Previously used servers box, and then clicking Connect. If the server and echosounder are located on another PC on the same network, it can be accessed by entering either the IP address or the machine name for the PC in question. The user may need to contact their systems administrator to get this information. Once an IP address has been used on the given client application, it is preserved for future use. On subsequent startups the client will attempt to automatically connect to the last known server. Note: any additional Server IDs are saved on the machine with the client. If another client is run on another machine, the server information needs to be entered on it as well.

Regardless of the connection option selected, once the user clicks on **Connect** the client application will attempt to establish communications with the server. If this communications connection is unsuccessful, then the client application will display an error message indicating the failure.

After the user acknowledges the error condition, the Server Connection dialog will reappear to allow the user to adjust the settings, or retry the original selections after verifying that the host PC has the server running. Once successful communication is established with the server, the EchoControlClient enables its main window and the control options applicable to the particular system or usage configuration. If there are no channels available for operation, most control options will be disabled.

3.2 Startup Options

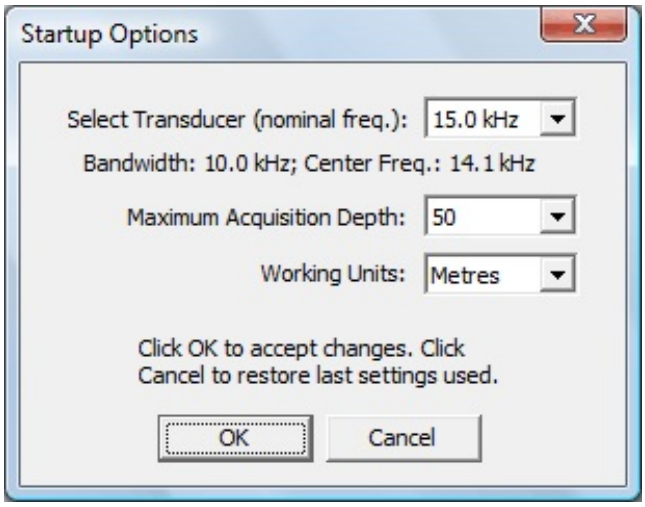
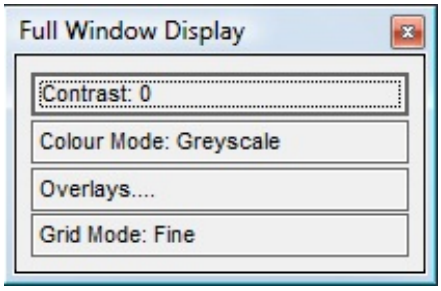
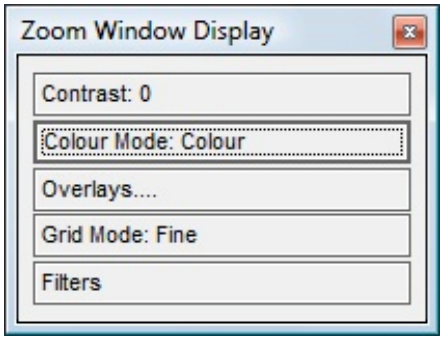


Figure 3.0: Startup Options Dialog

The Startup Options dialog appears each time the EchoControlClient application is started. Its purpose is to collect and/or confirm initial startup values for some critical parameters. The user can select the installed transducer (identified by its nominal frequency – more specific information is shown below the drop-down list), the maximum acquisition depth and the working units. Click OK to accept the selected contents of the dialog. Click Cancel to restore the settings used the last time the application was run.

3.3 Full Window Display *and* Zoom Window Display





There are two data display views presented in the application main window. These views are separated by a splitter bar that allows the windows to be adjusted in size. Each view has its own display controls dialog box, activated by double-clicking the view in question. The sections that follow describe the adjustments presented on these two dialog boxes.

NOTE: None of the display options adjustments will affect any of the recorded data. If the echogram data is being recorded to the binary file, the data is always stored in the same form it is received from the echosounder. All display transformations are applied independently from the recorded data.

3.3.1 Contrast

This option accesses the control that allows the user to increase/decrease the contrast of the displayed echogram data. This makes the data appear darker or lighter on the display without affecting the actual echogram data received from the sounder.

3.3.2 Colour Mode

There are seven colour modes available, plus a simple greyscale mode. The seven colour modes are: Basic-Clr, Base-Red, Base-Green, Base-Blue, Base-Magenta, Base-Cyan, Base-Yellow. When the Base colour modes are used, the most meaningful presentation is achieved with the Background: Black selection. See Table 5.0 for details regarding echogram level mapping.

Control Settings		Display Colour Usage		
Colour Mode	**Background**	**Background colour**	**Lowest level**	**Highest level**
Greyscale	**White**	White	White	Black
Reversed	**Black**	Black	Black	White
Colour*	**White**	White	White	Dark Red
Reversed	**Black**	Black	Black	Dark Red
Sidescan	**Black**	Black	Black	Yellow

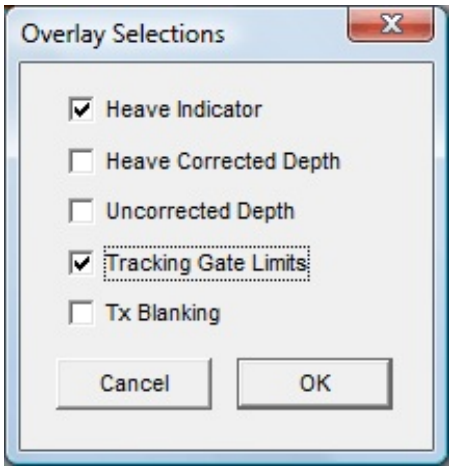
***** The Colour setting actually uses the 15 basic Windows colours mapped from lowest level to highest level as follows: White or Black (see table), Light Grey, Dark Grey, Cyan, Blue, Dark Blue, Dark Cyan, Dark Green, Dark Yellow, Green, Yellow, Magenta, Dark Magenta, Red, Dark Red. The other modes use a basic gradient from the lowest level colour to the highest level colour (see table).

3.3.3 Grid Mode

There are times, such as when the chart display is sharing the window with the Oscilloscope display or when the application window is sized to a small area, that the grid information can overwhelm and obscure the echogram data of interest. The Grid Mode option allows the user to select between no grid, a coarse grid or a fine grid to best suit his display needs.

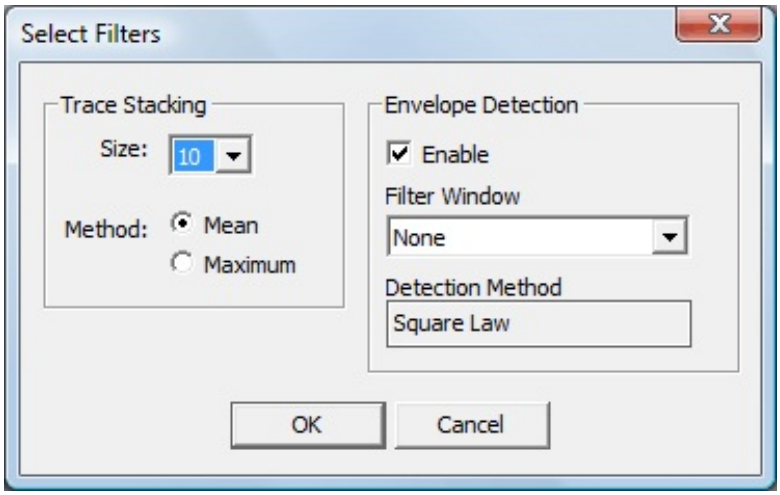
3.3.4 Overlays

If desired, data other than from the echogram can be displayed. The Overlays Selections dialog provides options for displaying additional data including:



- Heave Indicator – records the heave values as received from a heave sensor
- Heave Corrected Depth – records the detected depth corrected by the heave value
- Uncorrected Depth – plots the detected depth value uncorrected by heave
- Tracking Gate Limits – plots the upper and lower Tracking Gate Limits as lines parallel to the plotted depth
- Tx Blanking – blanks any echogram data above the Tx Blanking value

3.3.5 Filters (Zoom Window Display only)



Users have the option of applying filters to the Zoom Display data. Trace stacking combines from two to ten concurrent traces (the trace stack) and derives the displayed trace using one of two methods. If Mean is selected, the displayed trace is derived by averaging the data values in the stack. If Maximum is selected, the maximum values in the stack are used for each sample to create the displayed trace.

Envelope Detection, when enabled, allows the user to apply a filter window and detection method to the displayed data. Available filter windows are: None (no filtering), Rectangular, Cosine and Hamming. The detection method is selectable between Square Law and Amplitude.

4 APPLICATION TOOLBAR

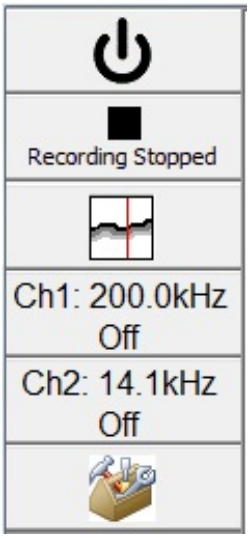


Figure 4.0: Application Toolbar

The **Application Toolbar** (Figure 4.0) can have five to eight buttons, depending on the number of channels configured for the system. The buttons are:

- Global Tx
- Record Start/Stop
- Manual Fix Mark
- Depth Channels (one or two depending on number of channels configured for the system)
- Setup

The functions of these buttons are described in the sections that follow.

4.1 Global Tx

As its name implies, the Global Tx button is a global on/off switch for all channels of the sounder system. Channels can also be individually enabled or disabled using the Tx Enabled button on the appropriate page of the Advanced Options dialog.

4.2 Record Start/Stop

This button starts or stops file recording as configured on the Configure Recording Options dialog.

4.3 Manual Fix Mark

Use this button to generate a manual fix mark. The keyboard shortcut Alt-M can also be used.

4.4 Depth Channels

The Depth Channel buttons display the channel number, center frequency and transmit status of the depth channel in question. Clicking on the button opens the channel's Depth Channel dialog. When viewing a Depth Channel dialog, the data for that channel is isolated in both the full chart and zoom chart displays. Only one Depth Channel dialog can be displayed at one time. The functions accessible from this box are the most commonly used parameters during a sounding session. The initial values for these controls are read from the server application. The dialog is initially shown in its collapsed form (see figure 4.1). Clicking the "+" button expands the dialog to show all the available controls. The Analog Gain display box also acts as a toggle to switch Automatic Gain Control off and on. The TVG Mode box also acts as a switch to cycle through the available TVG modes. The additional display boxes are also quick buttons to access control dialogs for adjusting the values of their respective parameters. Some controls also have adjustment arrows used to quickly increment/decrement the available values. The adjustment arrows affect the controls instantly, whereas the control dialog requires the user to accept the value before the sounder can utilize it. The Reset button returns all parameters for the channel in question to factory-defined defaults.

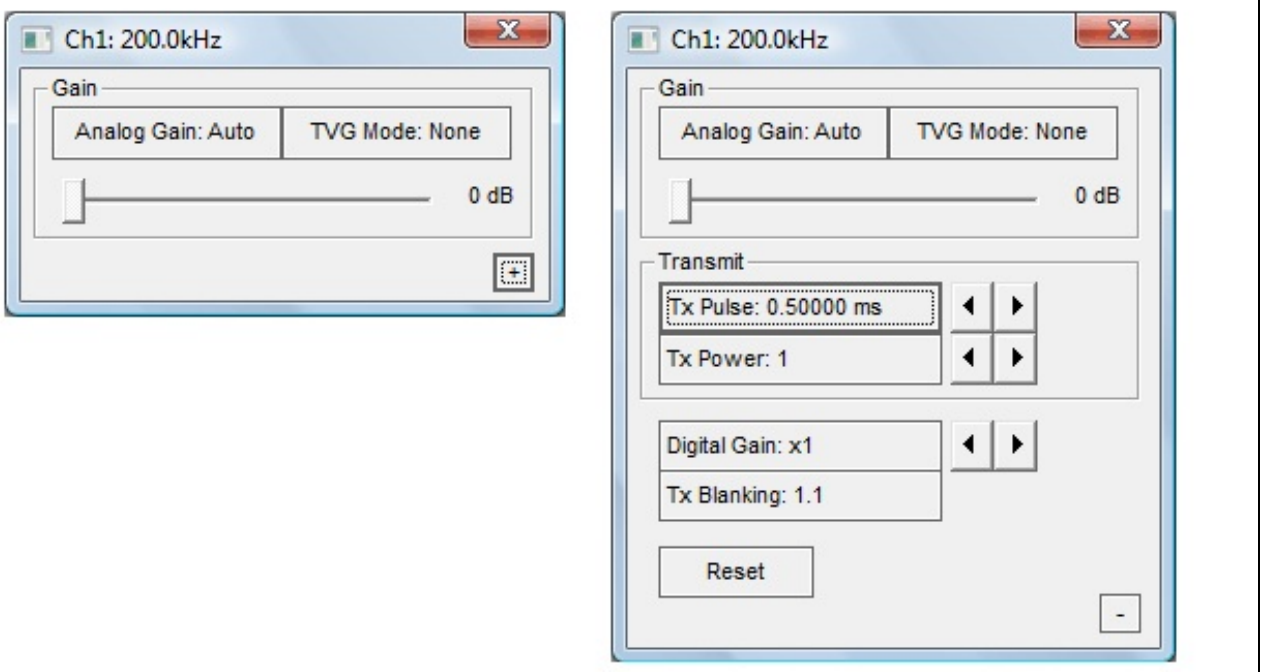


Figure 4.1: Depth Channel Dialog showing collapsed and expanded modes

4.4.1 Analog Gain: Auto/Manual

A channel's analog receive gain can be controlled either manually or in Automatic mode (AGC). Auto mode is the recommended setting for most operating conditions.

4.4.2 TVG Mode

This option allows the user to enable **TVG** (time varied gain) on the analog receivers. The **OFF** setting provides constant receive gain throughout each pulse-echo cycle (note that receive gain will still vary from ping to ping if **AGC** is on). When set to **20logR**, the receive gain is increased linearly (logarithmically if gain is expressed in decibels) with time and range from the instant of transmission, to compensate for signal amplitude loss due to spherical spreading. The **40logR** setting provides for spherical spreading of both outgoing and returning signals. The bottom referenced setting (**Bottom Ref'd**) provides a gain ramp at the bottom (as determined from the previous ping) to provide approximate compensation for attenuation in sub-bottom sediments. The last setting is intended for sub-bottom profiling applications.

For surveying operations, TVG may help to prevent the depth digitizer from falsely triggering on fish or other water column targets at the expense of a slightly greater susceptibility to locking on the second echo from the bottom. For sidescan operation, TVG may help to bring out weak returns in the far field allowing for improved detection of targets.

TVG operates in addition to the **AGC** or **manual gain** settings which are applied independently to each channel, and which

effectively define the starting gain for each channel at the instant of transmission.

4.4.3 Gain Slider

The **Gain Slider** is only available when the channel is setup to use manual gain. It controls the analog receive gain of the relevant channel. Reducing the analog receive gain is useful when sounding in extremely shallow water. This reduces the overall noise while not seriously affecting echo strength. Increasing the analog gain is useful when sounding in very deep water. The Gain value (in dB) is displayed to the right of the slider.

4.4.4 Tx Pulse

The **Tx Pulse** parameter allows the user to specify the pulse length (the duration of the transmit pulse) expressed in milliseconds.

4.4.5 Tx Power

The **Tx Power** parameter is used to specify the transmit power level of the pulse being transmitted. Power levels are controlled by changing the duty cycle of the switchmode transmitter output stage. Although high power signals will always give the strongest echoes, they also produce more ringing and reverberation which may obscure the bottom echo in shallow water. Using high receive gain in combination with high transmit power in shallow water may cause signal levels high enough to saturate (overload) the receiver, which will mask any echoes.

4.4.6 Digital Gain

The Digital Gainparameter provides for additional gain in the digital signal processing software. Sometimes the automatic gain control algorithm can force the signal processing module to overdrive, compromising the quality of the echogram data. A good rule of thumb is to start increasing the process shift when the AGC has to push the gain level over 45dB. This adjustment should be done gradually to slowly reduce the amount of analog gain required without applying too much digital processing gain (process shift). Applying too much process shift can cause the return echo to be saturated and distorted, compromising the digitization performance of the system.

4.4.7 Tx Blanking

The **Tx Blanking** parameter sets the transmit blanking distance used by the echosounder's internal digitizer to avoid false triggering on transmit reverberation.

The **Tx Blanking** value, or transmit blanking, is the distance (in the working units of the system), measured from the face of the channel's transducer, to the point in the water column at which the bottom detection software begins to look for the bottom. Transmit blanking must be set large enough that transducer ringing following the tail end of the transmit pulse is not falsely interpreted as the echo from a very shallow bottom, but small enough not to unduly limit the minimum depth capability of the echosounder. The optimum value depends on the expected depth conditions, the pulse length, the transmit power level and the signal frequency. It is best determined by experimentation.

4.5 Setup

The Setup button brings up the Setup sub-menu (see Figure 4.2). The bulk of the EchoControlClient application's functionality is accessible through the options on this sub-menu. Each is described in the corresponding section that follows.

4.5.1 Configure Recording

The **Configure Recording...** selection pops up a dialog box that allows the user to select the folder (or directory) where the data file set is to be recorded, the filename format used to identify the data set, and the desired output data formats (all can be active at the same time).

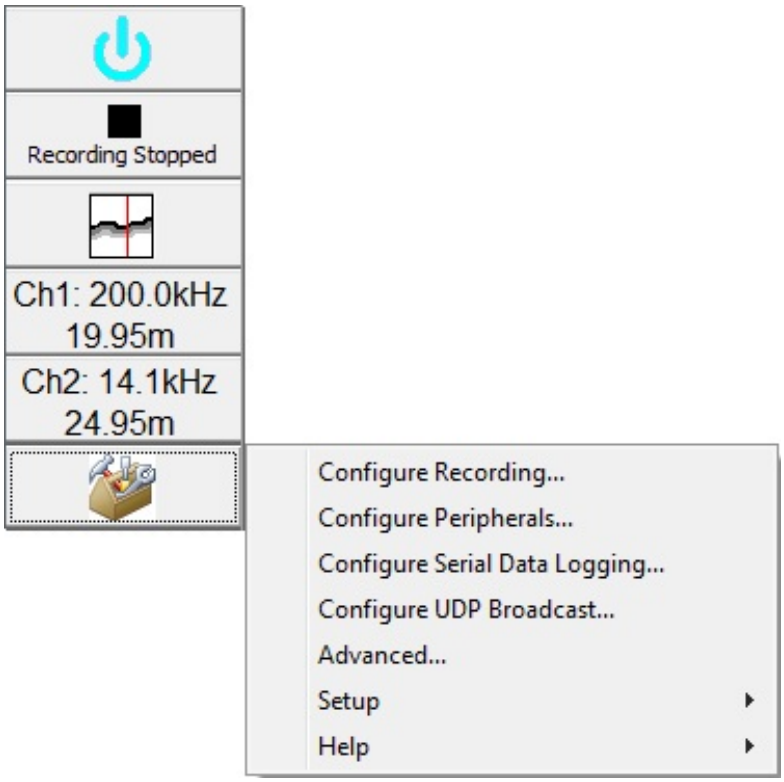
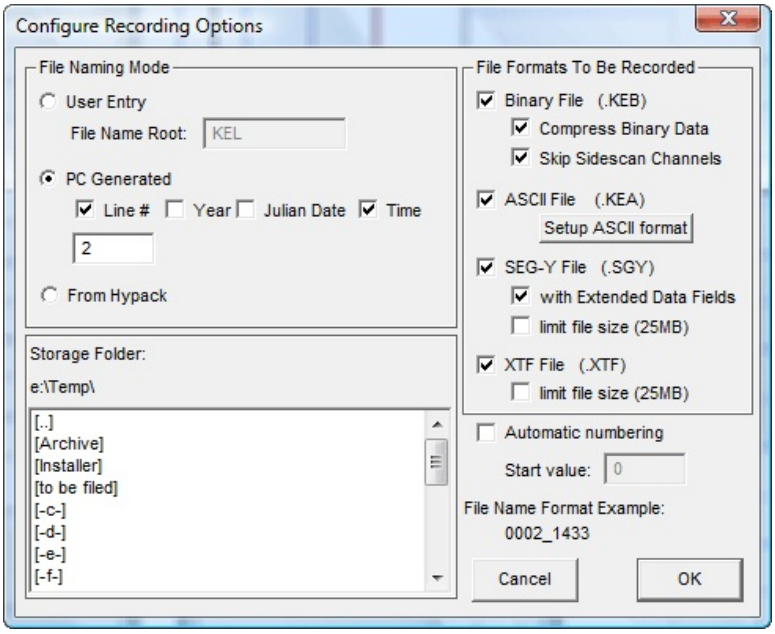


Figure 4.2: Setup Sub-Menu



4.5.1.1 File Naming Mode

With the **User Entry** option, the filename is based on the text entered by the user and an automatic numbering scheme. The user must exercise caution in this mode. Because the application will not allow a file to be overwritten that already exists, the user may not be able initiate file recording if the same name is used every time the application is started without ensuring a different Start value for the automatic numbering.

The **PC Generated** format is the most flexible format and the least likely to cause a conflict with identical file names except in the unlikely instance of two **Start Lines** within the same minute. If such a scenario happens frequently, the automatic numbering option will help to prevent duplicate filenames.

From Hypack is only useful if the supporting Hypack DLL is being used to transfer data, file and line info from Hypack Inc.'s Hypack Survey application. When it is employed, the EchoControlClient application will start and stop recording when Hypack starts and stops logging, and will use the file folder and name root sent from Hypack.

4.5.1.2 Automatic Numbering

This mode is enabled by default when the **User Entry** filenaming mode is active. Basically, when this mode is active, the filename is automatically appended with a number that starts at the value entered in the **Start value** box and automatically increments every time one recording file is closed and a new one started. Enabling this mode helps to prevent recording problems that occur when a file already exists with a particular file name.

4.5.1.3 Storage Folder

To modify the **Storage Folder** selection, the user simply double-clicks on the [..] to back up from the current directory, or double-clicks on the new directory or drive name desired. The currently selected folder is displayed in the text line above the selection box.

4.5.1.4 File Formats To Be Recorded

There are four possible output file formats: Binary, SEG-Y, ASCII and XTF. The SEG-Y format is only available for 3200 series systems using 32-bit processing modules. The XTF format is only available when there are sidescan channels configured. The KEL proprietary formats, KEB and KEA, are always available. Any combination of available formats can be recorded simultaneously.

4.5.1.5 Binary File Format (KEB)

The envelope data for each channel can be recorded in a binary data file for use by post-processing software. Every ping cycle, one record is stored with header information and raw data for each frequency channel. Each record is variable in length, and may be compressed using a Huffman compression algorithm. The storage device for these files should have sufficient disk space free to store the vast amounts of data generated, especially when working in shallow water where the faster ping rate results in a larger volume of data being generated.

See the File Format Specification KEB - D0 Format, Document # D101-04386 for complete formatting details

4.5.1.5.1 Compress Binary Data

When the **Compress Binary Data** box is checked, the application will compress all the KEB binary data records using a Huffman compression algorithm on each record. The File Type Id Preamble in each data file will indicate that Huffman compression has been applied. This control gives the user the option to store in a compressed or uncompressed format.

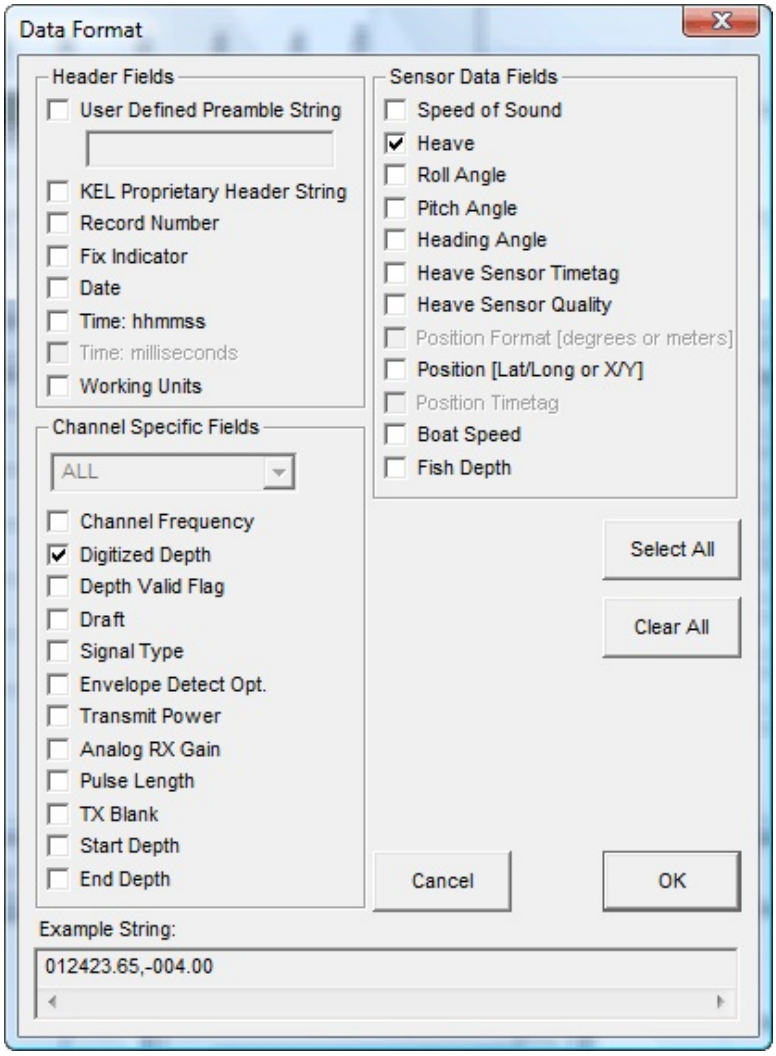
4.5.1.5.2 Skip Sidescan Channels

When the **Skip Sidescan Channels** box is checked, the application will only record the Bathymetry channels to the KEB format. The occasion when the user may want to select this is option is if the sidescan data is already being record into the XTF format and it is desired to save storage space.

4.5.1.6 ASCII File Format

The ASCII output file can be used to log many data fields such as depth, echosounder time, GPS position, and heave. Since these files do not contain any of the raw envelope data, they use substantially less disk space than the binary files. Every ping cycle, the application records one output string.

The user can request to modify the desired output data format by clicking on the **Modify ASCII output format** button. This causes the application to pop up a configuration dialog box with selection options for the desired data fields.



4.5.1.6.1 Setup ASCII format

This dialog box allows the user to customize the ASCII file format string with certain limitations. The fields can only appear in the order listed (ie header string, HF depth, LF depth, checksum) separated only by commas (except hhmmss and milliseconds), and terminated only at the very end by <CR>< LF>.

As various fields are selected or deselected, the **Example String** at the bottom of the dialog box changes to illustrate the expected output format. It will only put the sample info for one channel's worth of data. In the actual output file, for each channel present, its particular block of data fields is appended after the previous channel's block.

Some fields can only be selected if other fields are also selected and will be inactive (greyed out) if the required field is not selected. For example, the Position Latency field is an active option only if the Position field is selected.

The format configuration selected is stored in the application's registry keys and restored the next time the program is invoked.

4.5.1.7 SEG-Y File Format

The SEG-Y output file format has been defined to meet as accurately as possible the Rev0 format specifications defined by the Society of Exploration Geophysicists.

See the KEL SEGY FORMAT USAGE DEFINITION document, D101-03021, for complete formatting details.

4.5.1.7.1 SEG-Y Extended Data Fields

The original SEG-Y specification does not account for many useful data fields. If the user selects the option to include the extended data fields, numerous operation controls are recorded in the unassigned bytes at the end of the Rev0 Trace header. Some SEG-Y readers do not recognize files that contain data in these bytes so it is advisable to verify the requirements for the desired reader application before selecting this option.

See the KEL SEGY FORMAT USAGE DEFINITION document, D101-03021, for complete formatting details.

4.5.1.7.2 Limit File Size (25MB)

When data is recorded over a long period of time, the resultant SEG-Y files using the standard 20000 ping limitation can become so large some readers encounter difficulties reading them for playback and processing. To protect against this type of issue, the user can select the **Limit File Size** option to keep the files at a size usable by most SEG-Y readers.

4.5.1.8 XTF File Format

The XTF output file format is a specialized format used to record Sidescan and Bathymetry data. The format has been defined to be compatible with the standard as defined by Caris.

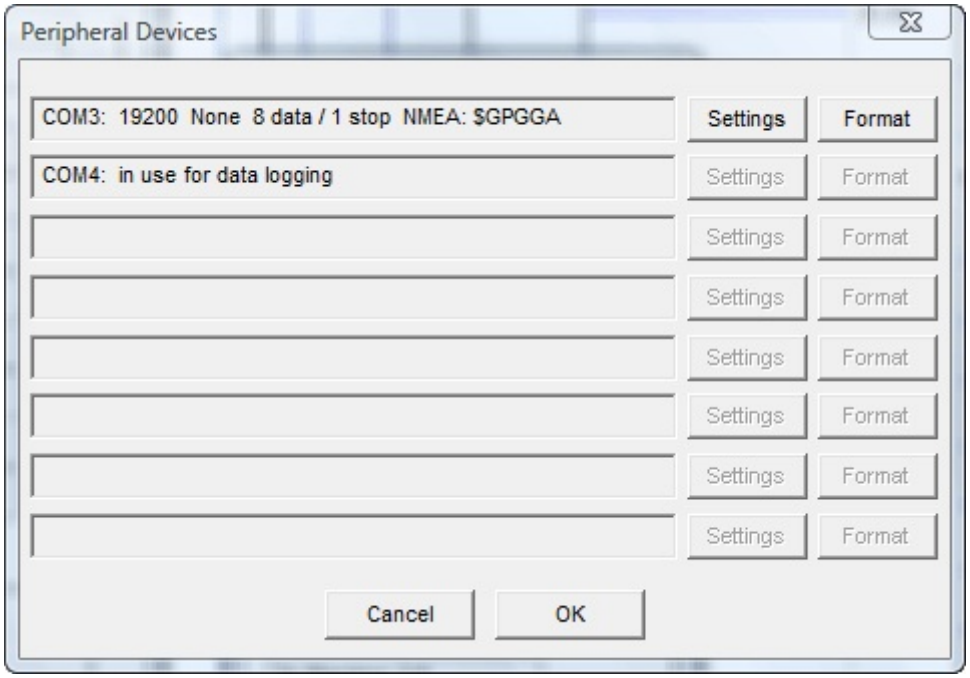
See the KEL XTF FORMAT USAGE DEFINITION document, D101-03322 for complete formatting details.

4.5.1.8.1 Limit File Size (25MB)

When data is recorded over a long period of time, the resultant XTF files using the standard 20000 ping limitation can become so large some readers encounter difficulties reading them for playback and processing. To protect against this type of issue, the user can select the **Limit File Size** option to keep the files at a size usable by most XTF readers.

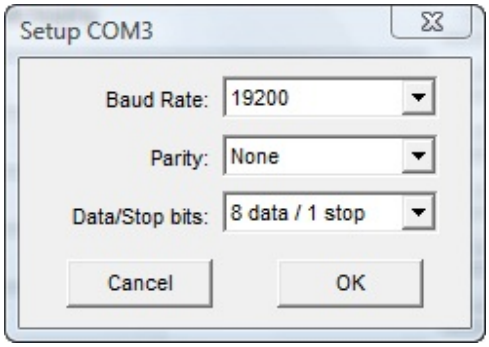
4.5.2 Configure Peripherals

While the peripheral devices connect to the server application on the host PC, the setup controls for these devices have been incorporated into the client application. The dialog that appears when this menu option is selected is a list of detected com ports on the server and their current status. If hosting a peripheral device, configuration information is displayed for that port.



At present, it simply assumes there may be as many as eight serial ports available on the host PC and it lists any device and communications settings currently in use . It is up to the user to know what serial ports are available on the host PC and where the particular peripherals of interest are connected. To add or modify any of the device settings, the user simply clicks the **Edit** box beside the desired COM port entry. This will bring up a dialog that provides access to the key settings required for configuring the port to accept data from the desired device.

4.5.2.1 Settings



4.5.2.1.1 Baud Rate

The baud rate can be adjusted to any one of the following options: 300, 600, 1200, 2400, 4800, 9600, 19200 and 38400.

4.5.2.1.2 Parity

All three options are available for parity: None, Even or Odd.

4.5.2.1.3 Data/Stop bits

There are two combinations of data and stop bits currently supported: 8 data, 1 stop or 7 data, 2 stop.

4.5.2.2 Format

The peripheral device formats supported by the server include:

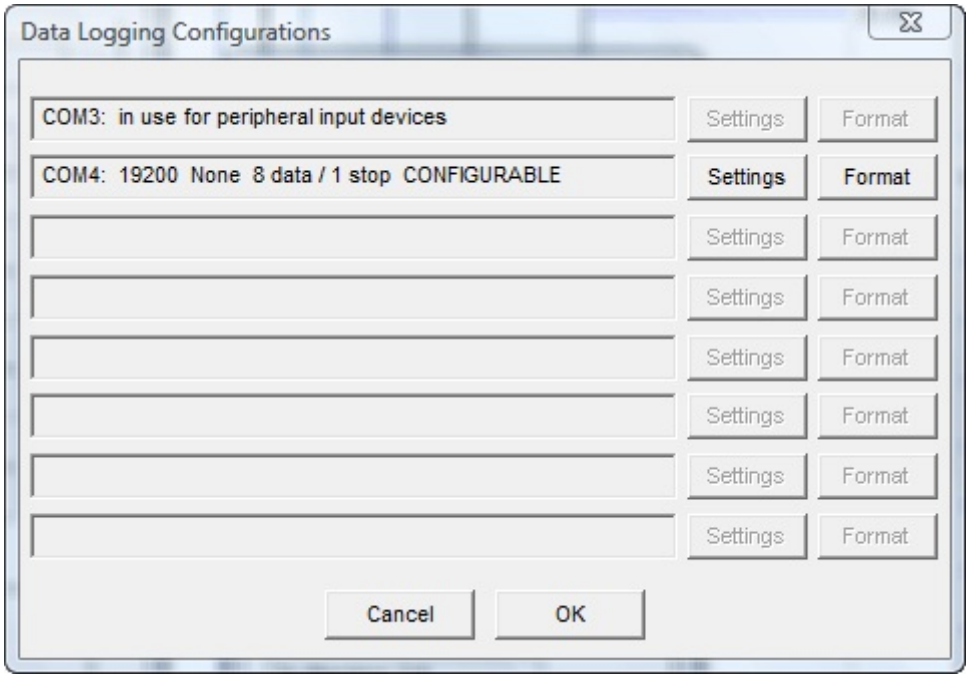
GPS Receivers:
- NMEA:GGA
- NMEA:GLL
- NMEA:GMP

Heave Sensors:
- TSS1
- TSS3
- POSMV EM1000
- POSMV EM3000
- Seatex: MRU
- Navy Remote

NOTE: The echosounder can support only one device of a particular type, such as one heave sensor or one GPS receiver. If one port has already been configured to a particular type of sensor, any attempt to configure another port to the same type of sensor will fail. For example, if COM1 has been configured for TSS1 (a heave sensor format), COM2 cannot be configured for either TSS3 or Seatex: MRU (other heave sensor formats).

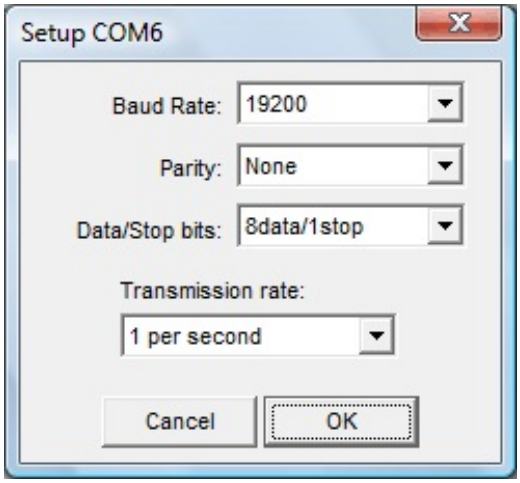
4.5.3 Data Logging

While the serial data logging is actually performed by server application on physical com port on the host PC, the setup controls for the data logging have been incorporated in the client application. The dialog that appears when this menu option is selected is a list of detected com ports on the server and their current status. If currently set up for data logging, configuration information is displayed for that port.



At present, it simply assumes there may be as many as eight serial ports available on the host PC and it lists any data logging format and communications settings currently in use . It is up to the user to know what serial ports are available on the host PC and where the datalogger systems are connected. To add or modify any of the device settings, the user simply clicks the **Format** box beside the desired COM port entry. This will bring up a dialog that provides access to the key settings required for configuring the port to accept data from the desired device.

4.5.3.1 Settings



4.5.3.1.1 Baud Rate

The baud rate can be adjusted to any one of the following options: 300, 600, 1200, 2400, 4800, 9600, 19200 and 38400.

4.5.3.1.2 Parity

All three options are available for parity: None, Even or Odd.

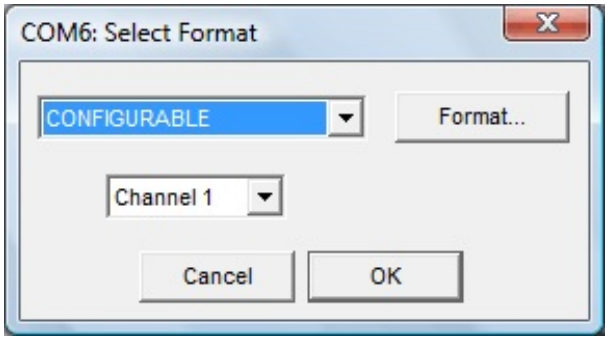
4.5.3.1.3 Data/Stop bits

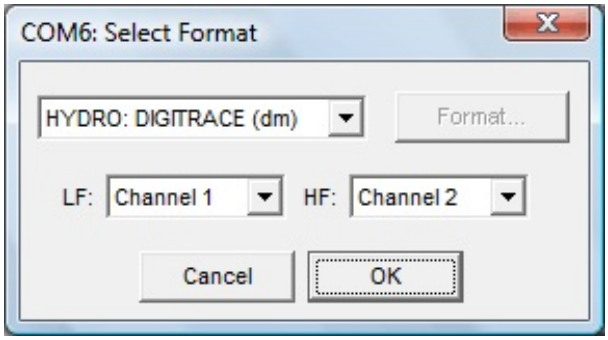
There are two combinations of data and stop bits currently supported: 8 data /1 stop or 7 data/2 stop.

4.5.3.1.4 Transmission Rate

Available transmission rates are: At ping rate, 5 per second, 4 per second, 2 per second, 1 per second, every 2 seconds, every 5 seconds and every 10 seconds.

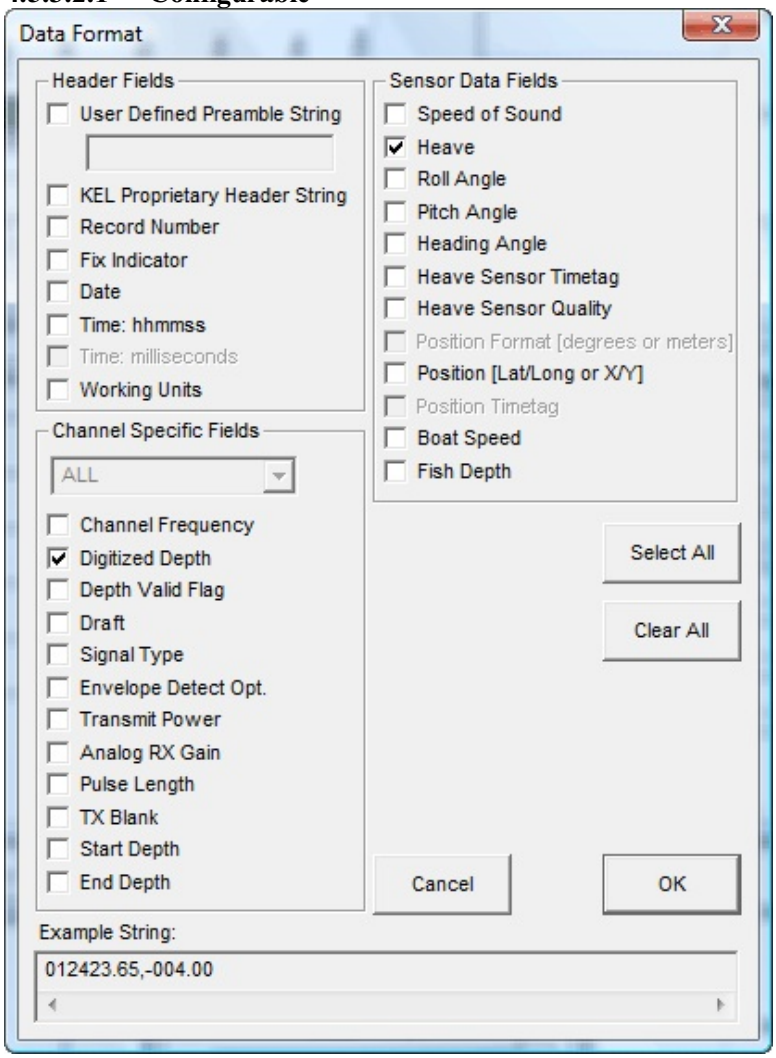
4.5.3.2 Format





There are various data logging output formats available ranging from a configurable user-defined format to industry standard protocols. The standard formats have predefined field assignments that cannot be adapted by the user. The user-configurable format can be customized, within certain limitations, to the user's desired configuration. The Select Format dialog (shown above) displays to appropriate controls for the output format selected.

4.5.3.2.1 Configurable



This dialog box allows the user to customize the ASCII format of the serial data logging string with certain limitations. The fields can only appear in the order listed (ie header string, depth, checksum) separated only by commas (except hhmmss and milliseconds), and terminated only at the very end by <CR>< LF>.

As various fields are selected or deselected, the **Example String** at the bottom of the dialog box changes to illustrate the expected output format. It will only put the sample info for one channels worth of data. In the actual output string, for each channel present, its particular block of data fields is appended after the previous channel's block.

Some fields can only be selected if other fields are also selected and will be inactive (greyed out) if the required field is not selected. For example, the Position Latency field is an active option only if the Position field is selected.

The format configuration selected is stored in the application's registry keys and restored the next time the program is invoked.

4.5.4 Configure UDP Broadcast…

The EchoControl software can transmit echogram data in ASCII format as UDP/IP datagrams. Selecting this menu option brings up the UDP Configuration dialog (figure 4.3). UDP transmission is performed by the server but configured through the client interface.

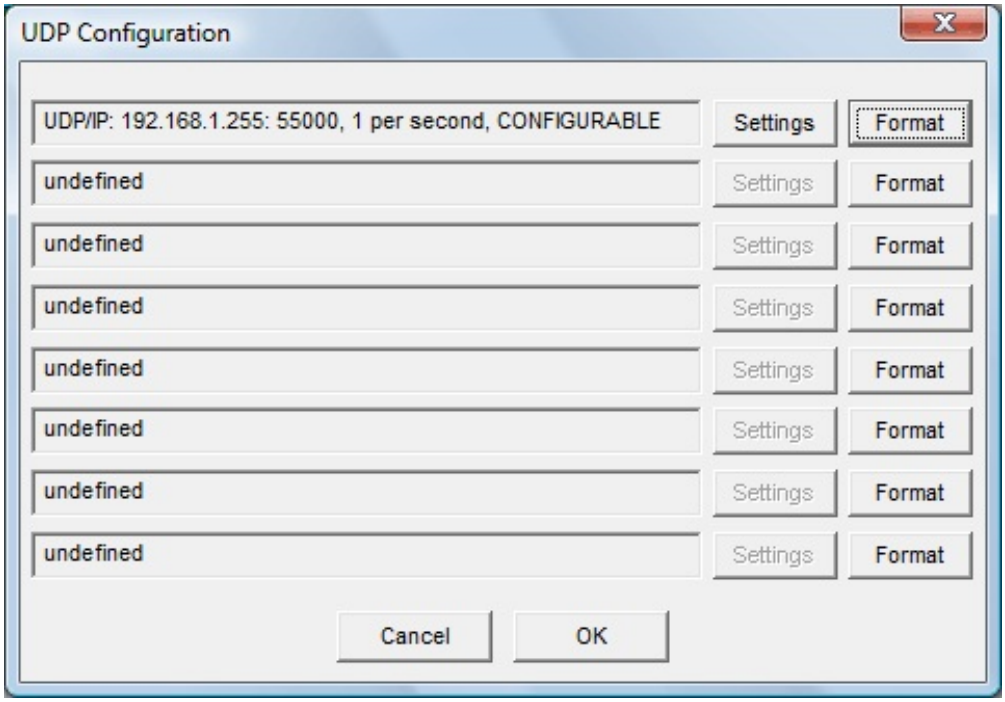


Figure 4.3: UDP Configuration Dialog

The UDP Configuration dialog shows the current UDP settings: IP address, UDP port number, transmission frequency and UDP message format. Clicking on the Settings button brings up the UDP Settings dialog to change these settings (figure 4.4).

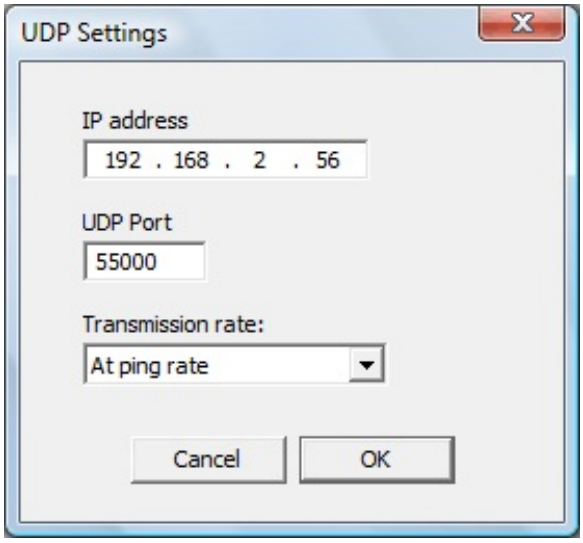


Figure 4.4: UDP Settings dialog

The IP address can be a broadcast address or single machine. The available Transmission Rates are: At ping rate, 5 per second, 4 per second, 2 per second, 1 per second, every 2 seconds, every 5 seconds and every 10 seconds.

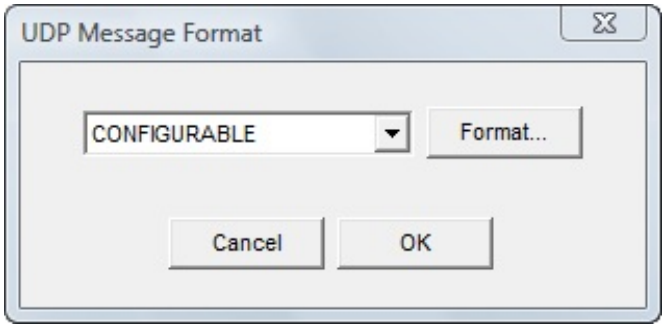


Figure 4.5: UDP Message Format Dialog

Clicking on the Format button brings up the UDP Message Format dialog (figure 4.5). Available options are NONE, CONFIGURABLE and NAVY REMOTE. When “CONFIGURABLE” is selected, the Format... button will open the Data Format dialog as shown in section **8.4.2.1.** Virtually any combination of comma-separated values can be configured.

4.6 Advanced Options...

The Advanced Options dialog has between two and five tabbed pages depending on the number of channels in the system. One to four Signal Controls pages (one for each channel) allow the user to adjust the assigned channel parameters. The System Setting page offers options for system-wide parameters such as Sound Speed and Working Units.

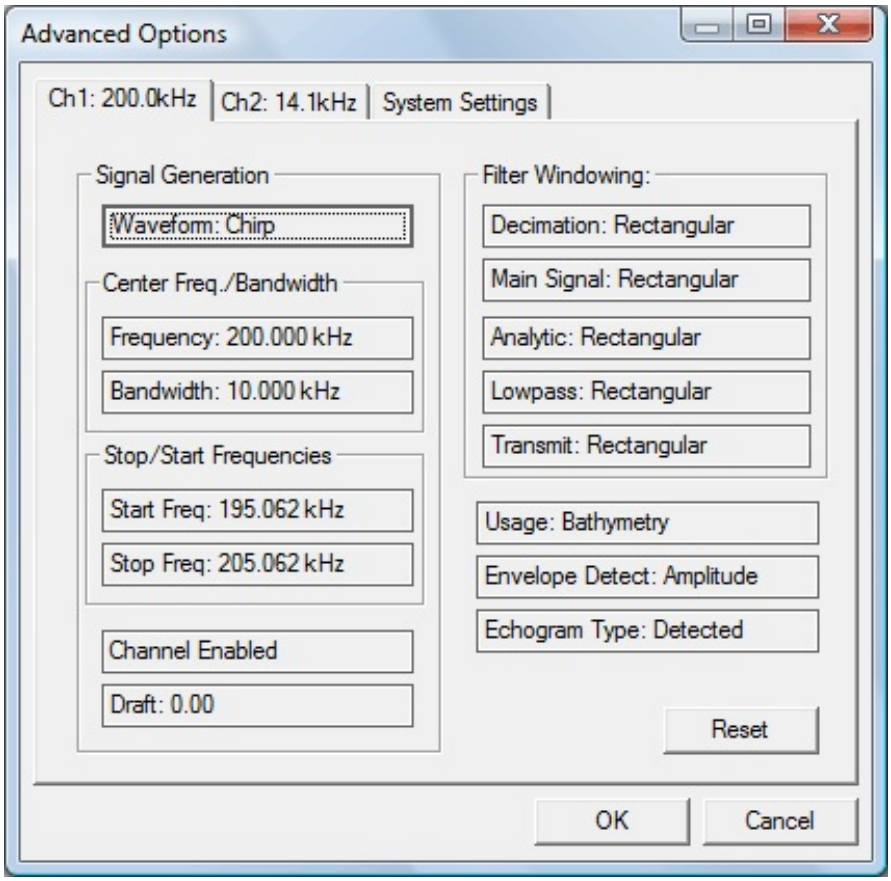


Figure 4.6: Advanced Options Dialog, Signal Controls Page

4.6.1 Signal Controls Page

The Pinger echosounders are frequency agile systems. The Advanced Options dialog, Signal Controls (see figure 4.6) page provides the user the ability to override the default channel assignments with alternate selections.

It is assumed that if a user is making modifications at this point that they have a detailed understanding of the physical configuration within the echosounder. Improper configuration of the hardware could result in poor system performance. This is not a recommended section for inexperienced users. Please contact the appropriate technical support if the sounder is not properly configured for the operational requirements.

4.6.1.1 Waveform

Selects whether the signal generation and signal processing use CW (or tone signals) and passband filters, or if it uses Chirp pulse generation and correlation processing.

4.6.1.2 Frequency

This control adjusts the nominal operational centre frequency used for signal generation and processing. If this value is changed, the Start and Stop Frequencies (below) are automatically adjusted.

4.6.1.3 Bandwidth

The user can adjust the bandwidth used for signal generation and processing. If this value is changed, the Start and Stop Frequencies (below) are automatically adjusted.

4.6.1.4 Start/Stop Frequencies

In addition to the Center Frequency and Bandwidth, the Start and Stop Frequencies can also be adjusted. These values represent the starting and ending frequencies of the Chirp waveform. They are irrelevant to Continuous Wave (CW) operation. When either of these values is changed, the Frequency and Bandwidth are automatically adjusted.

4.6.1.5 Channel Enable

This control determines whether or not a channel is enabled for transmission. When enabled, the channel will acquire, digitize and log data when the Global Tx control is on. When disabled, channel operations are turned off and will remain off regardless of the state of Global Tx.

4.6.1.6 Draft

Draft indicates the vertical distance, in the working units of the system, from the surface of the water to the active face of the transducer. Its main use is to ensure that the echosounder's output is corrected for the transducer depth.

4.6.1.7 Filter Windowing

There are various digital filters applied through the signal processing code to extract and isolate the return echo from the background environmental noise. These digital filters can use various windowing options to enhance their filtering characteristics. The options available are: rectangular, hamming and cosine.

The main thing the user should watch, if he decides to adjust the windowing, is to use the same window type for the main signal filter and the transmit filter. This will ensure the best correlation results since the transmitted pulse will more closely match the anticipated correlation signal.

4.6.1.8 Usage

The **Usage** option selects the operational mode of the channel. The operational mode determines where and how the echogram data is displayed in the EchoControlClient application as well as what data file formats are available for recording. Currently there are three modes: bathymetry for downward looking channels used for depth detection and sub-bottom profile; Sidescan Port for (as the name implies) the port channel of a sidescan configuration; and Sidescan starboard for the starboard channel of a sidescan configuration. Sidescan channels are displayed in the waterfall display mode section (scrolling top to bottom) with the port channel on the left half of the display region and the starboard channel on the right half of the display region. Bathymetry channels are displayed in the chart display section (scrolling right to left) in either overlayed presentation or stacked depending on the display mode setup.

4.6.1.9 Envelope Detect

There are two modes of envelope detection available on the Pinger series echosounders. The standard square-law detection mode improves the signal-to-noise ratio of the echogram data by helping to pull out the signal return level from the background noise. In some applications (sidescan and sub-bottom profiling) it may actually be of interest to see the background noise level. In these situations, the user can switch to the amplitude detection mode.

4.6.1.10 Echogram Type

The Pinger sounders are capable of providing echogram data for recording and display. This data is available in two specific format types from a channel's signal processing module.

Filtered: This is the signed data after it has been through the digital correlation filter but before it has been envelope detected.

Detected: This is the envelope detected data available at the original signal sampling rate.

4.6.2 System Settings Page

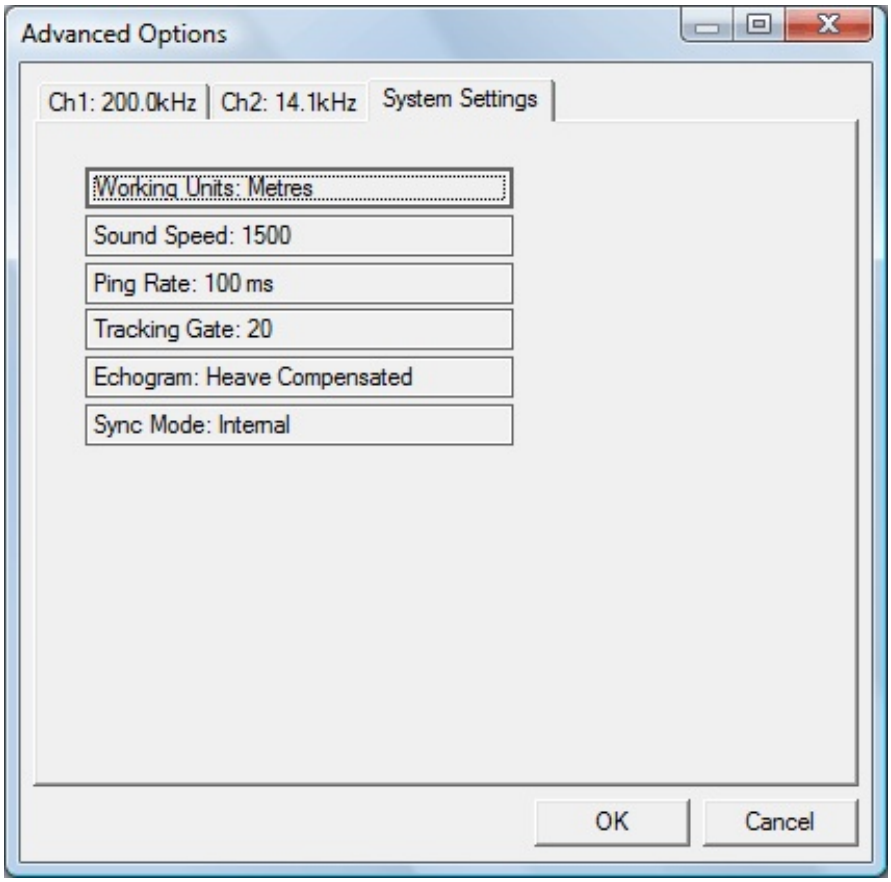


Figure 4.7: Advanced Options Dialog, System Settings Page

The **System Settings Page** (see Figure 4.7) provides access to system-wide parameters used by the echosounder. They are described in the following sections.

4.6.3 Working Units

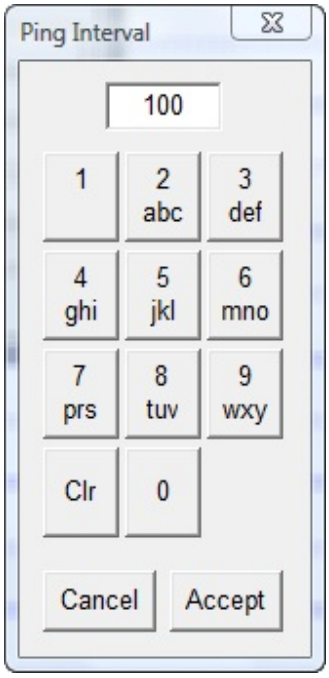
The **Working Units** option allows the user to select the desired operating units from three options The operating **Units** can be selected from **Metres**, **Feet**, and **Fathoms**. When these units are switched, the echosounder converts the speed of sound and draft to the appropriate new units.

4.6.4 Speed of Sound

This feature allows the adjustment of the velocity of sound value used by the echosounder for all depth calculations. The user adjusts this value in the course of a bar check, or enters the average expected velocity of sound over the water column of interest, obtained from a speed sensor.

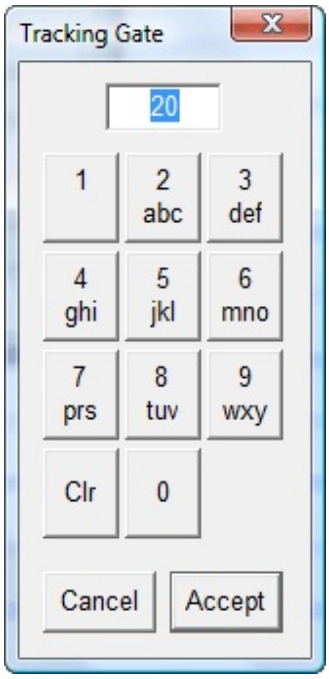
4.6.5 Ping Rate

The EchoContolServer application controls the echosounder's ping rate based on either range, the 1% duty cycle transmit limitation or the user-selected ping rate whichever is the largest value. The user can adjust this ping rate to the optimal value for his application. The echosounder will then ping at this rate if possible; built-in ping rate limitations may override the basic value selected here.



4.6.6 Tracking Gate

The **tracking gate** parameter is used by the bottom tracking algorithm to determine the validity of the current depth value. It is a depth variability tolerance value, defined as a distance above or below the bottom depth trend established by the current and several previous samples. If the most recent depth value fits this established trend to within the range defined by the **tracking gate**, it is considered valid and is displayed in the appropriate dialog boxes. If a depth return falls outside of this range, it is deemed invalid and "0.0" is displayed in all the dialog boxes with depth displays.



4.6.7 Echogram: Heave Compensated/Uncompensated

When enabled (Heave Compensated), the echogram data is compensated for heave as detected by a heave sensor. When disabled, the echogram data is displayed as received.

4.6.8 Sync Mode: Internal/External

This switch specifies whether pings will be triggered internally (by the sounder module) or externally (by an external module connected to the sounder unit through the Sync In connector, if applicable).

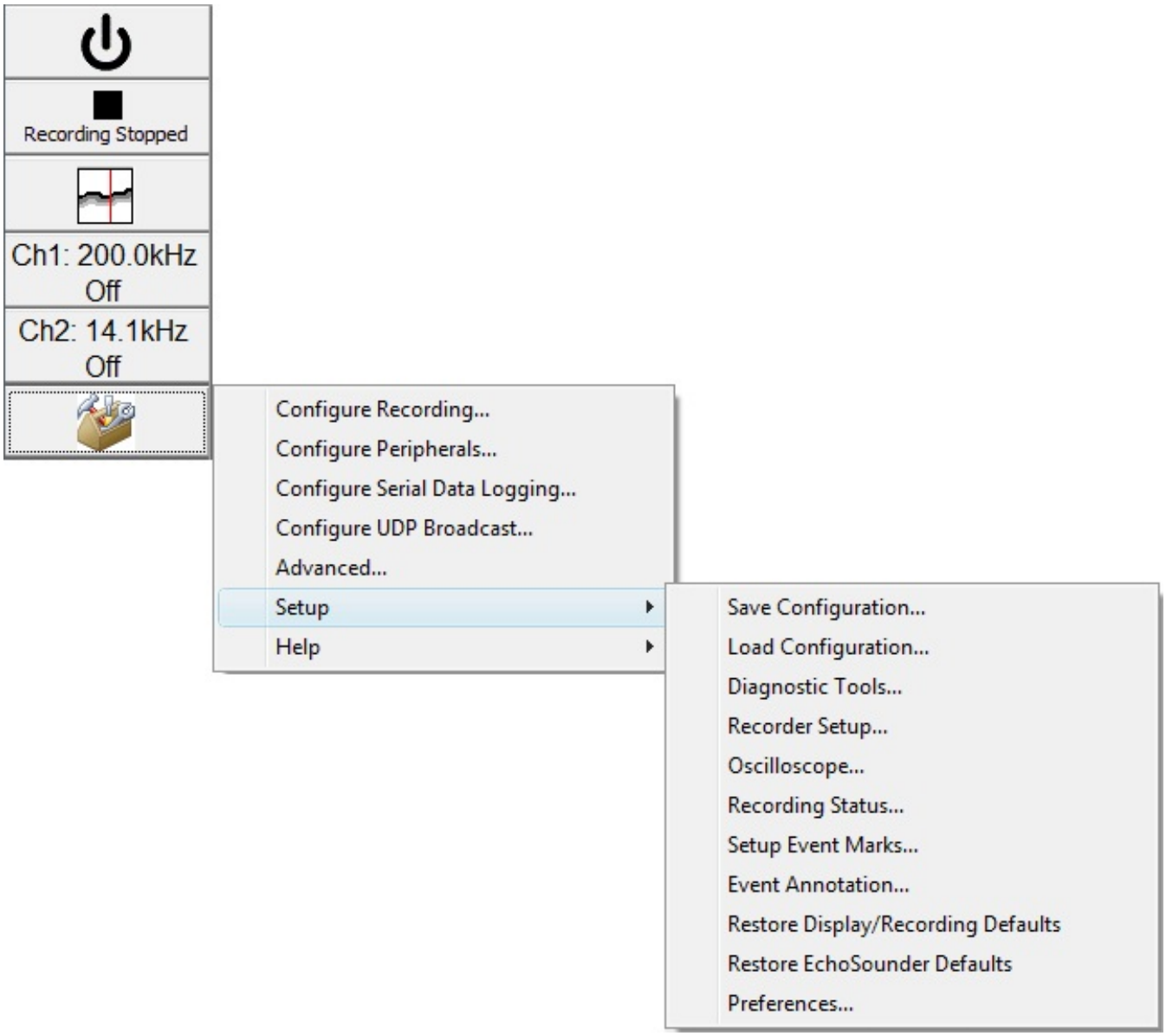


Figure 4.8: Setup Sub-Menu

4.7 Setup Sub-Menu

4.7.1 Save Configuration

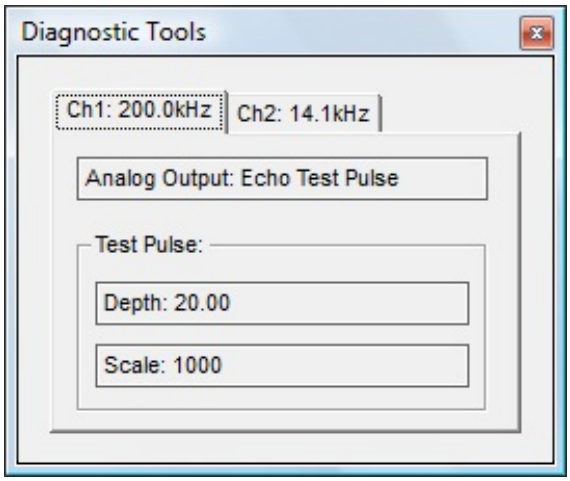
The Save Configuration menu option will save the current Channel, System, Range/Phase, Com Port and Pinger Mode settings in a file of the user's choosing.

4.7.2 Load Configuration

This menu option allows the user to load Channel, System, Range/Phase, Com Port and Pinger Mode settings previously saved using the Save Configuration option.

4.7.3 Diagnostic Tools

The Diagnostic Tools are settings that a technician can use to test and verify the functionality of the echosounder. These controls are not recommended for the general user; the control option for Analog Output should be left at None to prevent any interference with the normal operations of the echosounder.



4.7.3.1 Analog Output

The **Analog Output** setting defines the signal type available at the test pulse generator header on the signal processing module. There are various selections which allow for the output of a replica of the detected signal during its various stages of digital filtering. There is also a test depth simulation mode that allows for testing of the signal processing module without requiring transmitter cards and transducers to be connected. This mode is currently only useful if there is a test cable installed between the test pulse generator and the analog receiver input on the sounder module.

4.7.3.1.1 Test Pulse

The test pulse control options are only available when the Analog Output is set to Echo Test Pulse.

4.7.3.1.2 Depth

The Depth parameter is the desired location of the simulated echo return.

4.7.3.1.3 Scale

The Scale parameter is the amplitude of the simulated echo return..

4.7.4 Recorder Setup

The EchoControlClient application supports real-time printing of the echogram data to various thermal recorder models. The thermal recorders typically connect to the client PC via the parallel port or the USB interface. The Recorder Setup mode provides access to the parameter specifically for customizing the hardcopy printing. These controls are completely independent of the various display mode settings. ie The display could be showing four channels stacked whereas the thermal printout could have them overlayed together.

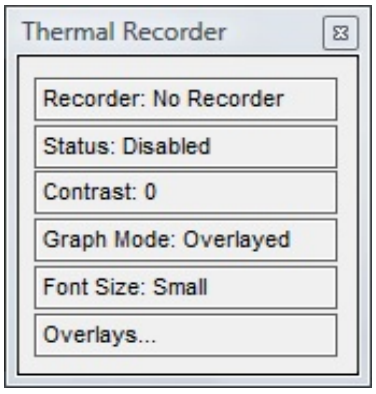


Figure 4.9: Thermal Recorder Setup Dialog

4.7.4.1 Recorder

There are a number of thermal recorder models supported by the client application. There are as follows: EPC Labs 9800, GSP1086 and HSP-100 models, ODEC's TDU-850, iSys V8.5e and V12, GeoAcoustics GeoPrinter 9315, as well as KEL's own USB printer.

4.7.4.2 Status: Enabled/Disabled

The hardcopy printing on the thermal printer can be disabled or enabled as desired using the Status toggle. This control allows the recording to be disabled without having to change the actual thermal recorder selection itself.

4.7.4.3 Contrast

This contrast control allows the user to increase/decrease the contrast of the printed echogram data. This makes the data appear darker or lighter on the record without affecting the actual echogram data received from the sounder.

4.7.4.4 Mode

There are three printing mode options available.

1. **None** turns the display off. No echogram or event data is displayed in this mode.
2. **Overlayed** displays all the channels, overlayed together, using the entire chart display height.
3. **Stacked** displays all the channels separately, with Channel 1 at the top and sequentially going down the display.

4.7.4.5 Font Size

Depending on the data presentation on the chart, sometimes larger fonts for the grid and other text annotation is easier to read; sometime smaller fonts are preferred. The user has the option to toggle between the large and small font options.

4.7.4.6 Overlays

If desired, other data than from the echogram can be plotted on the recorder. The Overlays Selections dialog (figure 5.9) provides options for recording additional data. They are:

- Heave Indicator – records the heave values as received from a heave sensor
- Heave Corrected Depth – records the detected depth corrected by the heave value
- Correction Offset – offsets the Heave Corrected Depth plot by a specified number of working units to make the data more readable
- Uncorrected Depth – plots the detected depth value uncorrected by heave
- Tracking Gate Limits – plots the upper and lower Tracking Gate Limits as lines parallel to the plotted depth
- Tx Blanking Limits – plots the Tx Blanking value, above which the bottom detection algorithm does not search; echogram data is still displayed above this line
- Tx Blanking – blanks any echogram data above the Tx Blanking value

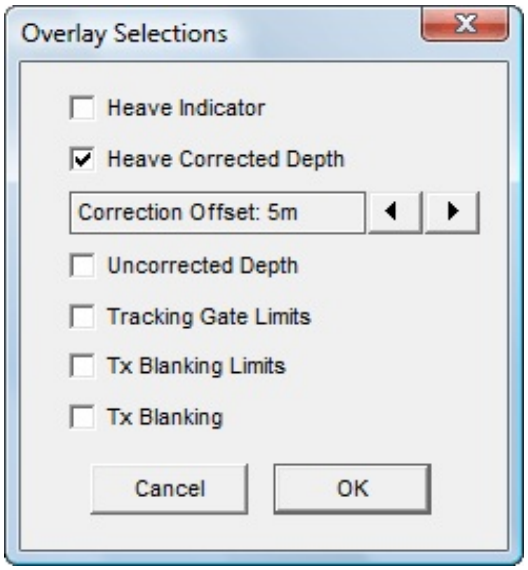


Figure 4.10: Overlay Selections Dialog

4.7.5 Oscilloscope

This menu option brings up the Ping Chart dialog, the main feature of which is an oscilloscope to view echogram data (figure 4.11).

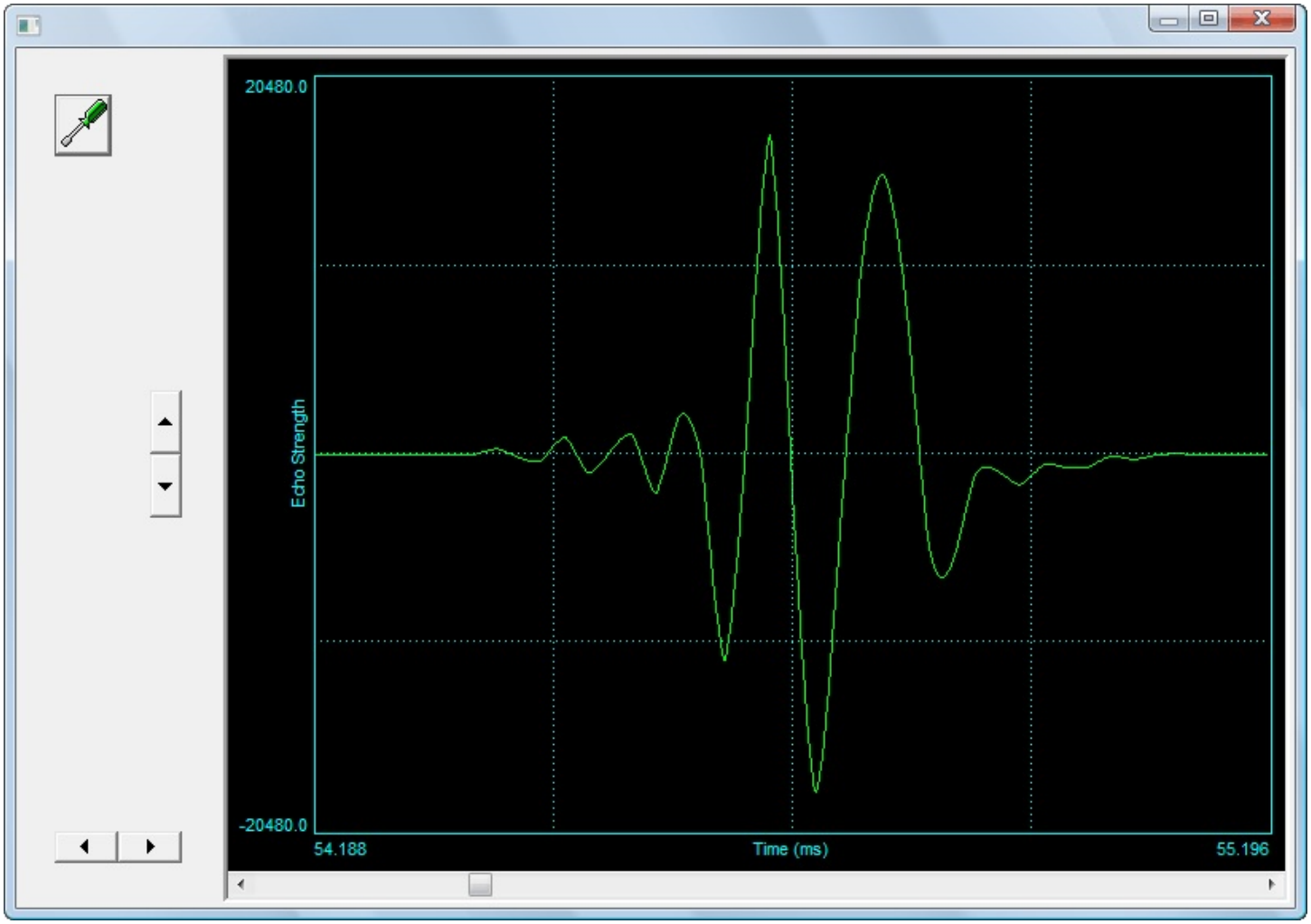


Figure 4.11: Ping Chart Dialog

There are five controls on the Ping Chart dialog: The Tools button (identified by the  icon), two spinner controls to adjust the vertical and horizontal scale, a horizontal scroll bar at the bottom of the scope control and the scope control itself.

The Tools button brings up the Oscilloscope Config dialog (Figure 4.12).

Controls on this dialog allow the user to select Data Type (toggles between Carrier Data and Envelope Data), Channel (a list box displays all configured channels) and Horizontal Scale Units (toggles between Time in milliseconds and Number of Samples).

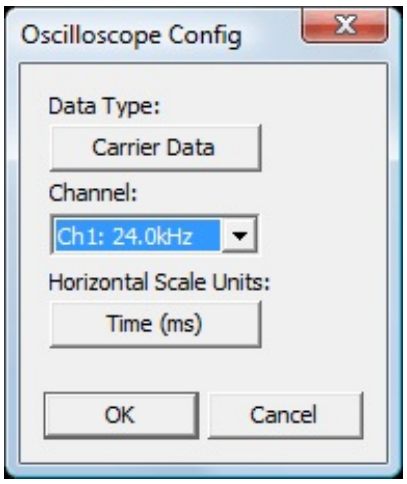
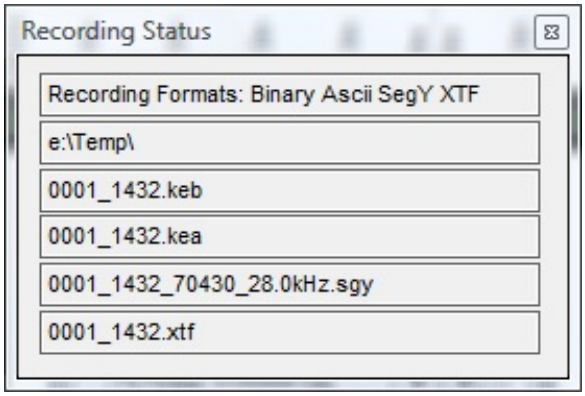
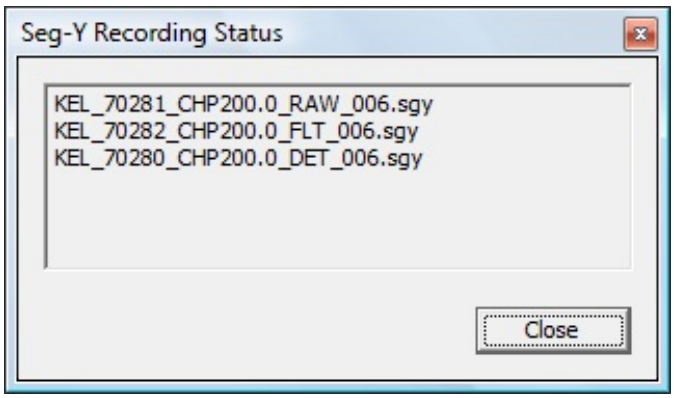


Figure 4.12: Oscilloscope Config dialog

4.7.6 Recording Status

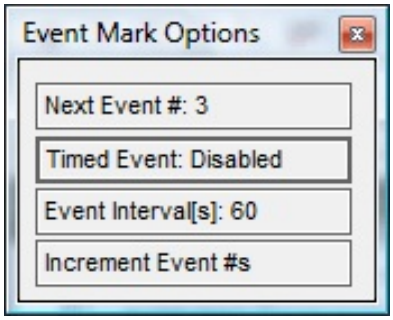


The **Recording Status** dialog displays the current status of any file recording that is active on the EchoControlClient application. It provides information regarding the file types being recorded, the storage path where they are recording, and the name of any files currently open for recording. Clicking on any data display box in this dialog while the recording state is inactive will activate the **Configure Recording Options** dialog (see Section 7.3). Clicking on any data display box in this dialog while the recording state is inactive will activate the **Configure Recording Options** dialog (see Section 7.3).



When recording Seg-Y format files, depending on your configuration, multiple files may be recorded. If more than one channel is recording Seg-Y data, the Recording Status dialog displays the number of channels. Clicking on the Seg-Y data display box in this case brings up the **Seg-Y Recording Status** dialog. This dialog displays the names of all Seg-Y files being recorded. If only one channel is recording Seg-Y data, the filename is displayed on the Recording Status dialog in the same manner as files of other formats.

4.7.7 Setup Event Marks



The **Event Marks** option pops up a dialogue box that allows the user to adjust the event marking options.

4.7.7.1 Next Event

The **Next Event** indicates what number the echosounder's event counter will use on the next event mark. The user can adjust this to any value between 1 and the maximum value 65535.

4.7.7.2 Timed Event: Enabled/Disabled

The **Timed Event** toggle allows the user to select whether to use the echosounder's internally timed event marks or not.

4.7.7.3 Event Interval

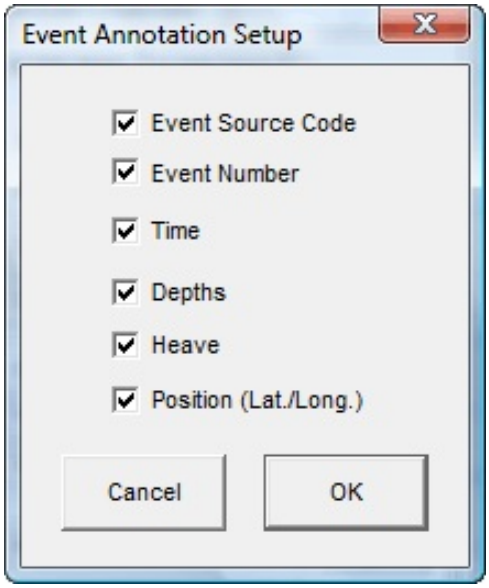
If Timed Event is enabled, the echosounder will cause internally generated event marks at the time interval selected in the **Event Interval** box. The units for this interval measurement are seconds.

4.7.7.4 Increment/Decrement Event #s

The event marks can be configured to count up (increment) or count down (decrement). When the event number reaches zero on the count down, it wraps to the highest value supported (65535). When the event number reaches this maximum value on the count up, it wraps back to zero.

4.7.8 Event Annotation

(Application parameters)

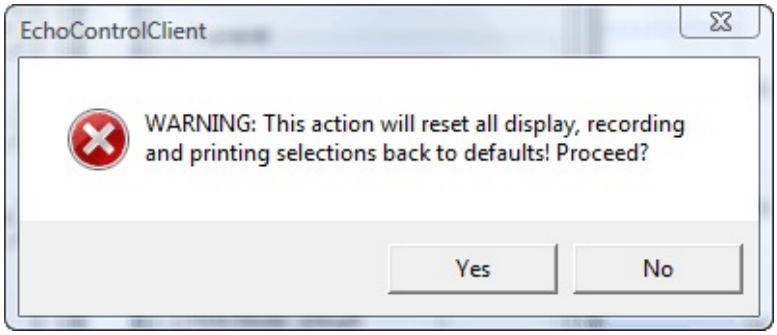


This menu item brings up a dialog box that allows the user to select which of the available data parameters will be printed out on the event mark annotation line. The selections made here apply to the display and the thermal recorder output. The user has no control of the ordering of the parameters; they are output in the order they are listed if they are checked off.

4.7.9 Factory Defaults

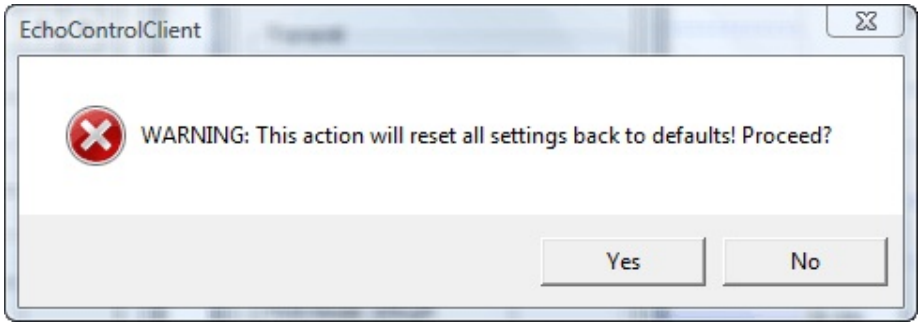
Occasionally, after a software/firmware upgrade has been performed or a new site setup is required, it is advisable and convenient to restore the sounder controls or the client display and recording controls back to factory default. This enables starting the sounder from a known default state. As discussed in Section 2.3, there are Echosounder controls and Application Controls. The reset commands for the Factory Defaults have been divided into two separate commands to allow the user to decide if he wants to reset the Echosounder or Application controls only, or if he wants to reset them all.

4.7.10 Display/Recording Controls



When the user selects the option to reset the Application display and recording controls, the client application will prompt the user for confirmation to proceed with the action. This prevents accidental modification of the settings when it may not be desired.

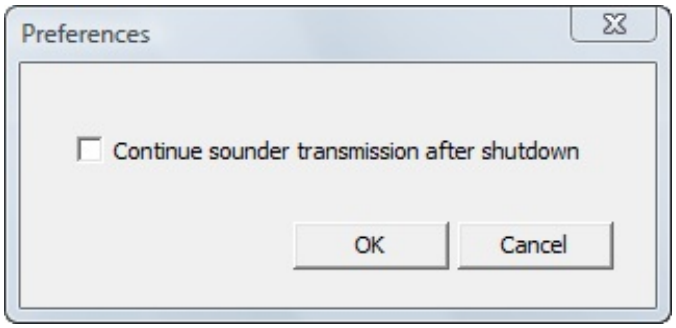
4.7.11 EchoSounder Controls



When the user selects the option to reset the Echosounder controls, the client application will prompt the user for confirmation to proceed with the action. This prevents accidental modification of the settings when it may not be desired.

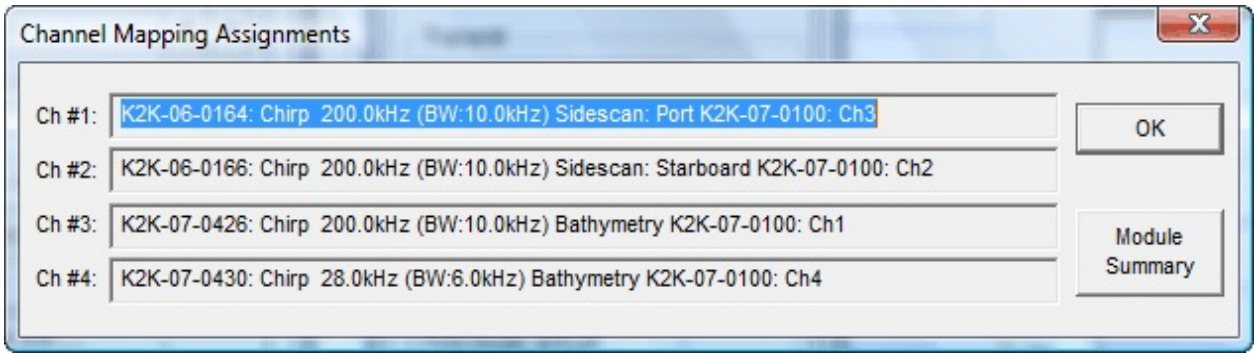
4.7.12 Preferences…

The Preferences... menu selection brings up the Preferences dialog. Selecting the “Continue sounder transmission after shutdown” option allows pinging to continue after EchoControl Client has been shut down.



The **Help** menu provides access to information dialogs that provide the user with system configuration information that is most useful when contacting the factory for technical assistance. There are no other help features implemented at this time.

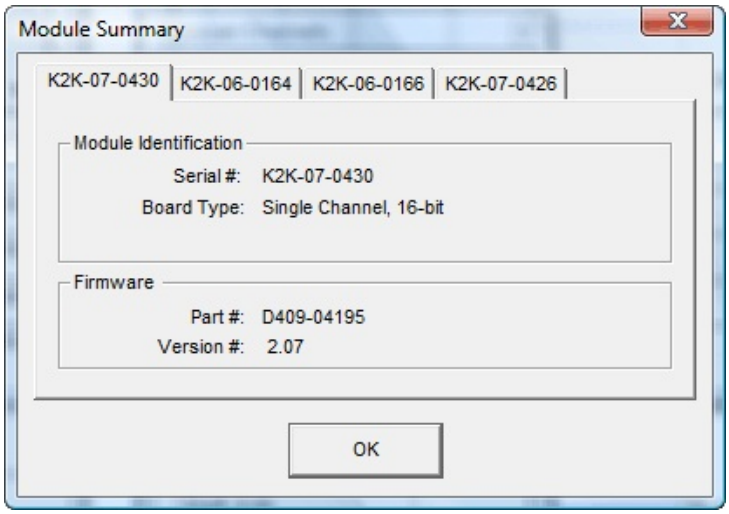
4.8 Sounder Info



When the server application starts, it scans the USB bus for all available KEL echosounder hardware modules and catalogues a list of these modules. It uses the frequency and board serial number information for each module to sort and organize the modules sequentially by frequency (highest to lowest) and, if there are duplicate frequencies, by serial number (lowest to highest). The Channel Mapping Assignments dialog provides a listing of this assignment list determined by the server.

The user can determine what physical modules were actually detected by clicking the **Module Summary** button.

4.8.1 Module Summary



The **Module Summary** dialog simply provides information regarding the hardware channels detected in the sounder by the server application. For each hardware module, it reports the programmed serial number, the module's type and its available channels, plus the firmware part number and version. This is a useful reference for verifying the hardware status in the sounder.

4.9 Tech Support

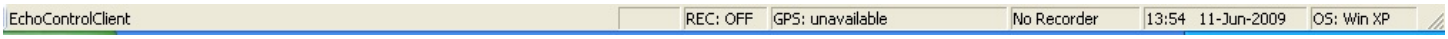
This option brings up a simple dialog box that provides contact information for technical support. It also provides information about the type of Windows operating system the EchoControlClient program has detected.

4.10 About EchoControlClient...

The **About EchoControlClient...** menu item brings up a simple dialog box stating the name of the PC software program, the KEL part number for the program, and the latest revision number.

4.11 Status Bar

(Application parameters)



This control allows the user to enable and disable the application's status bar. The status bar is located at the bottom of the application's window. The status bar provides helpful messages that describe menu controls, and other useful items. These messages include, from left to right, if applicable:

- Menu help tips
- Pinger distance measurement (Chirp 3200/scientific systems only)
- Recording Status: REC: off for none, B for KEB, A for KEA, S for SEG-Y, and X for XTF
- GPS position data (if GPS is connected and pinging is active)
- Thermal recorder selection
- PC time and date
- Version of operating system detected.

SounderSuite-USB

PostSurvey

Supports Software: D409-03171 V2.xx

D101-03175
Revision 4.0
July 6, 2009

Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario, Canada

CONTENTS

1 INTRODUCTION. . . . 1-1
1.1 About this manual. . . . 1-1
1.2 Software Description. . . . 1-1
1.3 Technical Support. . . . 1-1

2 OPERATING INSTRUCTIONS. . . . 2-1
2.1 Description. . . . 2-1

3 File. . . . 3-1
3.1 Open. . . . 3-1
3.2 Close. . . . 3-1
3.3 Copy to Clipboard. . . . 3-1
3.4 Save to Bitmap. . . . 3-1
3.5 Save Portion. . . . 3-1
3.6 ASCII Dump. . . . 3-2
3.7 Print. . . . 3-3
3.8 Print Preview. . . . 3-4
3.9 Print Setup. . . . 3-4
3.10 Thermal Recorder. . . . 3-4
3.10.1 Setup. . . . 3-5
3.10.2 Send Data. . . . 3-6
3.11 Exit. . . . 3-6

4 View. . . . 4-1
4.1 Channel Data. . . . 4-1
4.2 Parameter Data. . . . 4-2
4.3 Signal Data. . . . 4-2
4.4 Depth Chart. . . . 4-3
4.5 Ping Chart. . . . 4-3
4.6 Status Bar. . . . 4-4
4.7 Main Toolbar. . . . 4-4
4.8 Info Toolbar. . . . 4-4
4.9 Settings Toolbar. . . . 4-4
4.10 Channel Toolbar. . . . 4-5
4.11 Active Global Scroll. . . . 4-5

5 Settings. . . . 5-1
5.1 Contrast. . . . 5-1
5.2 Display. . . . 5-1
5.2.1 Colour. . . . 5-1
5.2.2 Reverse Colour. . . . 5-2
5.2.3 Digitized Line Display. . . . 5-2
5.2.4 Embedded Grid Text. . . . 5-2
5.2.5 Embedded Grid Lines. . . . 5-2
5.2.6 Reverse Display. . . . 5-2
5.2.7 Waterfall Display. . . . 5-2
5.2.8 Zoom Display. . . . 5-2
5.2.9 Text Size. . . . 5-2
5.3 Event Annotation. . . . 5-3

5.4 Colour Selection. 5-3
5.5 Alternate Printer. 5-4

6 Window. 6-1
6.1 Cascade. 6-1
6.2 Tile. 6-1
6.3 Arrange Windows. 6-1

7 Channel. 7-1

8 Help. 8-1
8.1 About PostSurvey. 8-1
8.2 Tech Support. 8-1

LIST OF TABLES

Table 3-1: Supported Thermal Recorders. 3-5

1 INTRODUCTION

1.1 About this manual

This manual provides information about the Playback and Printing application, D409-03171, PostSurvey.exe. This program has been designed to review previously recorded USB Echosounder data files and to produce hard copies on selected thermal recorders and windows printers.

1.2 Software Description

The USB Echosounders developed and produced by Knudsen Engineering Limited were designed with a USB interface for transferring detailed envelope data and parameter settings. PostSurvey is a specially designed Windows-compatible program created to play back data records offline from the sounder and to create hard copy records. In addition to support for the Knudsen Engineering Limited proprietary file format (KEB), this application also supports XTF and SEG-Y Rev.0 formats.

1.3 Technical Support

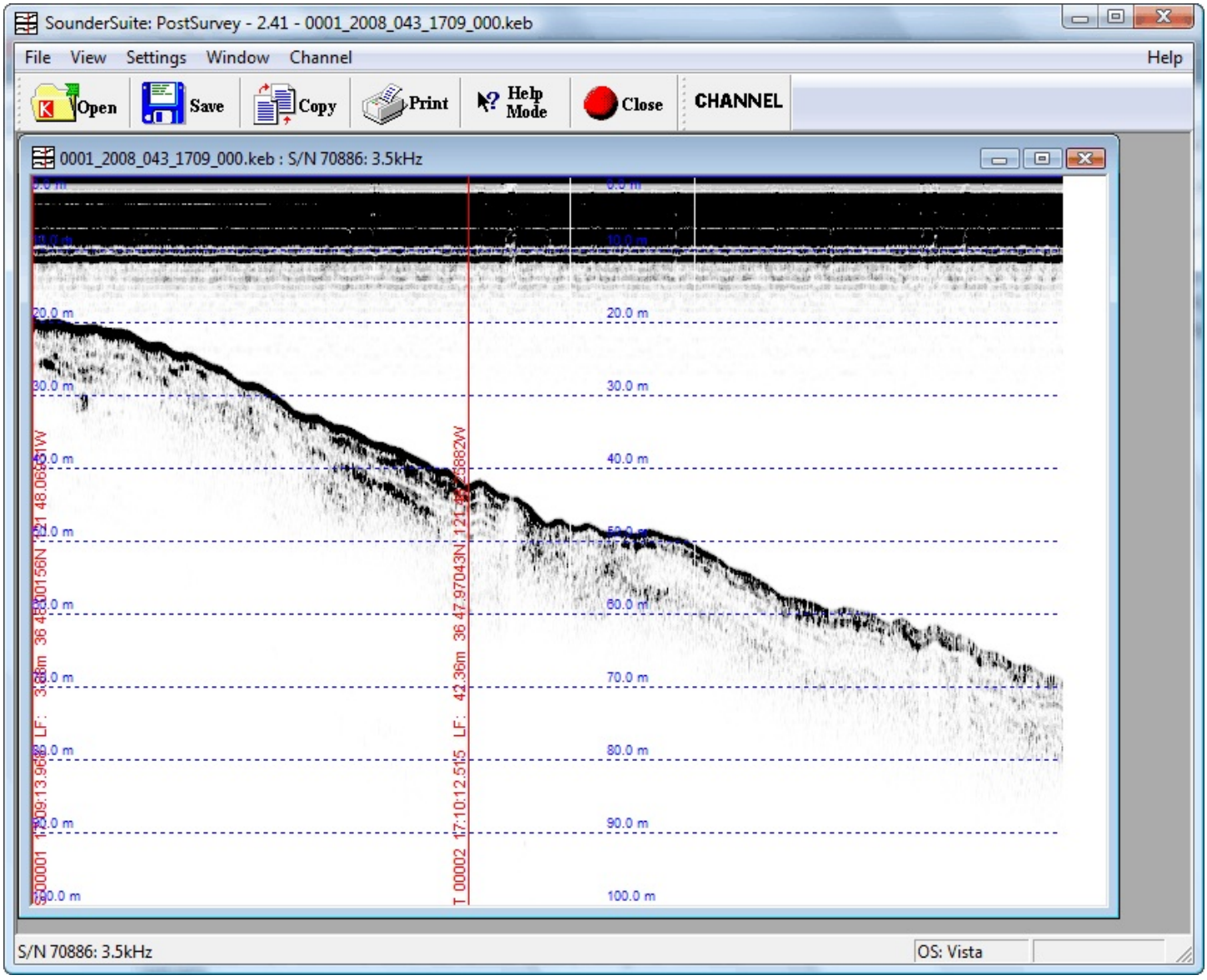
For technical support or to report problems please contact your local representative or:

Technical Support
Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario
K7H 3P2

Voice: (613) 267-1165 8:30 am to 5:00 pm E.S.T. Core Hours
Fax: (613) 267-7085
E-Mail: support@knudsenengineering.com
WebSite: http://knudsenengineering.com/

2 OPERATING INSTRUCTIONS

2.1 Description



The PostSurvey software is a multiple document interface Windows program design that provides the capability for data playback and printing of multiple KEL Echosounder (KEB), XTF and SEG-Y data files on the PC. When the program is invoked, it creates a window with three control groups offered on the main menu bar (with limited functionality), a blank display area for greyscale or colour presentation of the echogram playback. Once a properly formatted KEB (D0, D1, D2 or D3 format), XTF or SEG-Y data file has been opened, an additional control group is added to the main menu bar and many more options are added to the original control groups.

3 File

3.1 Open

If the **Open** command is selected, the program responds with a File Selection dialog box to access the files. When a valid file (.keb, .xtf and .sgy) is opened, the data from that file will be loaded into memory and displayed starting with the first ping in the selected file.

3.2 Close

An opened file and all its associated windows can be closed using the **Close** command. This option is not active if a file is not already opened.

NOTE: An individual window can also be closed by clicking on the close button (X) located on the top right side corner of the active window.

3.3 Copy to Clipboard

This command is used to copy the image within the currently active window to the clipboard in a bitmap format which can then be copied into another graphical program for further editing.

Note: This option only copies what you see on the screen. If the user requires more than what is able to be viewed on the screen then it is better to use the Save to Bitmap feature instead.

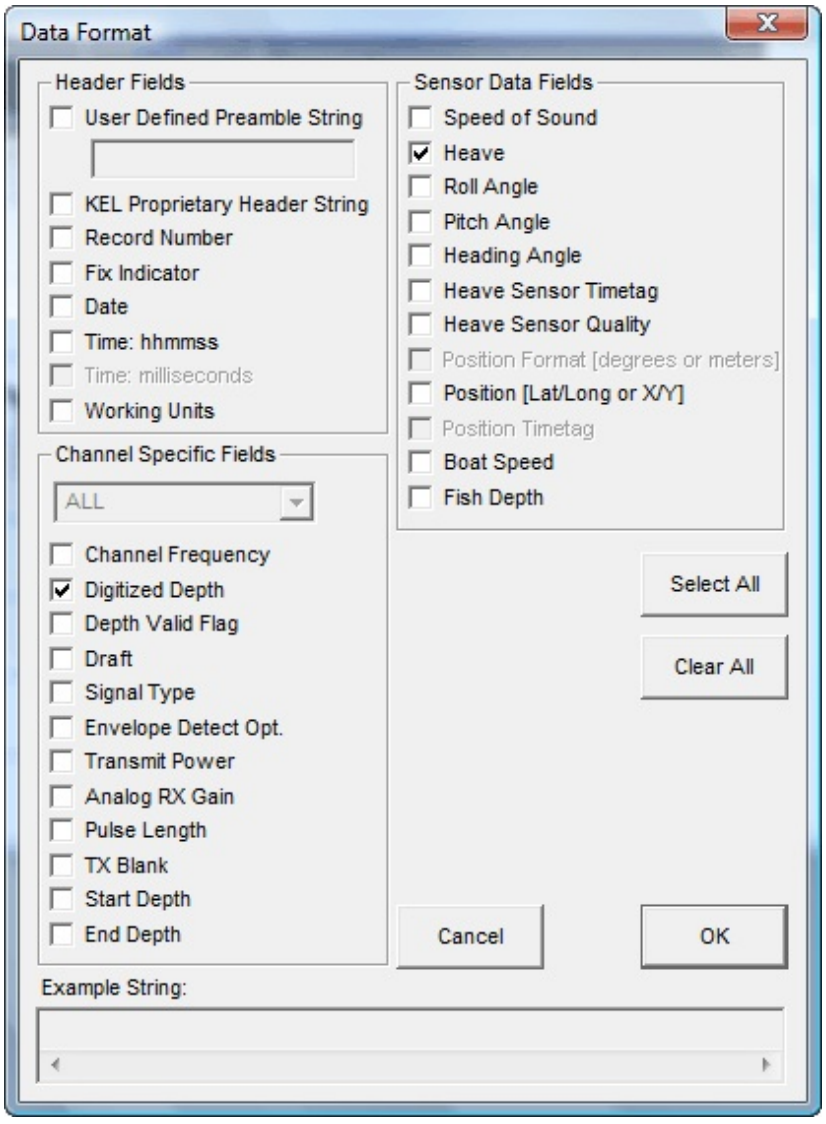
3.4 Save to Bitmap

The **Save to Bitmap** command saves the entire image for the currently active window to a DIB (.bmp) file. This command will save the data for only a single channel out of a data set. If a data set has more than one channel, the user will be prompted for the channel selection before the Save As dialog appears. The Save As dialog is displayed to allow for the selection of a name and location for the new image file.

3.5 Save Portion

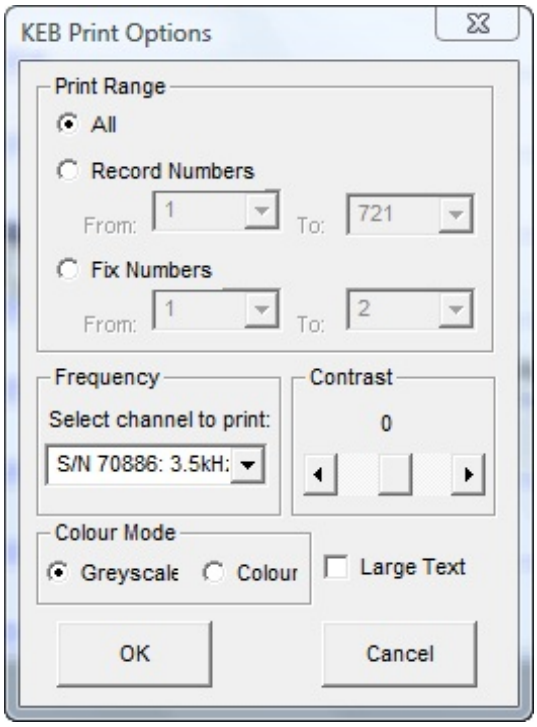
This command allows the user to select a portion of the currently active document to be saved to a new KEB file in the latest recording format. Once this command has been selected the user will be prompted with a Save dialog box to allow them to choose a name and location for the new file.

3.6 ASCII Dump



The ASCII Dump option will allow the user to select a variety of fields from the currently active data set that they would like to record into a new standard ASCII file. The new file will have the extension .kea, however the user can select the name and location through the standard Save As dialog box.

3.7 Print

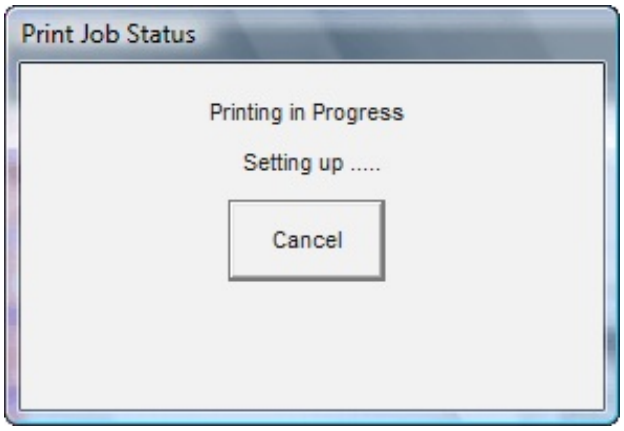


The **Print** option allows the user to print the entire data set or limited sections of the set to any Windows printer. This option is only available if a valid KEB, XTF or SEG-Y Data file is opened.

When the **Print** option is selected, depending on the file format of the currently active document the appropriate dialog box pops up that allows the user to setup printout presentation options similar to the screen options: Greyscale/colour mode, display mode, contrast (see Section 5.2). The Print Range option provides the user with the ability to select the entire line file set or only a section of the line file set to print. The printout can be limited to print between Record Numbers or Fix Numbers (if any exist).

Once the print options have been OK'd, the standard print dialog box appears. This allows the user access to the printer setup to change from the current default printer, and to modify printer setup options. Once all the desired selections are made and the user clicks on OK, the printing will begin. Currently, any printer setup selections made for the current print job will be lost on the next, and have to be re-selected.

NOTE: There is a Cancel Print capability but it has limited response capability once the printing procedure has started. Because the printouts are very graphically intensive and most systems print graphics quite slowly, the user should be certain he really wants to proceed before clicking OK in the Print dialog box.



NOTE: this menu option is only used to send data to standard Windows printers, not thermal recorders. Use the **Thermal Recorder: Send Data** command to print to thermal recorders.

Important information: The printed envelope output is very graphically intensive. Some printers with on-board memory may have problems with data overflow; reducing the print quality (resolution in dpi) may minimize this problem but it also reduces the quality of the printout. Preliminary testing with a limited number of printers had the best presentational results with the following printer setup options (click Setup in the Print dialog box to access): Landscape mode, Fine dithering, and the highest resolution available to the printer (this is a printer specific option). For users of Windows 95/98, the spooler options should be setup as follows to avoid creating excessively large temporary files (which can quickly over flow hard drives with limited available space): printing should start after the first page has spooled, and the spool data format should be RAW not EMF. In some cases, it may even be better to disable spooling altogether and send the data directly to the printer.

3.8 Print Preview

This option is not fully implemented at this time.

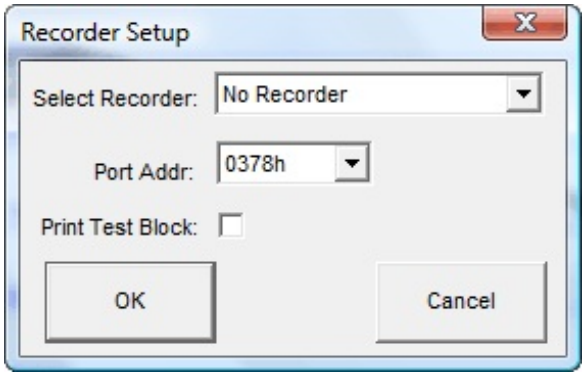
3.9 Print Setup

This option is not fully implemented at this time.

3.10 Thermal Recorder...

This menu option provides access to two sub-menu items that allow the user to setup and send data to a thermal recorder. This option is only available if a valid KEB data file is opened

3.10.1 Setup



This option brings up a dialog box that allows the user to select a thermal recorder to be used for making hardcopies.

Table 3-1: Supported Thermal Recorders

Manufacturer	Models
EPC Laboratories	9800, GSP-1086, HSP-100
ODEC	TDU-850
iSys	V8.5e, V12
GeoAcoustics	9315

The **EPC GSP-1086** driver expects the user to have set the following parameters to the values listed via the unit's front panel menus:

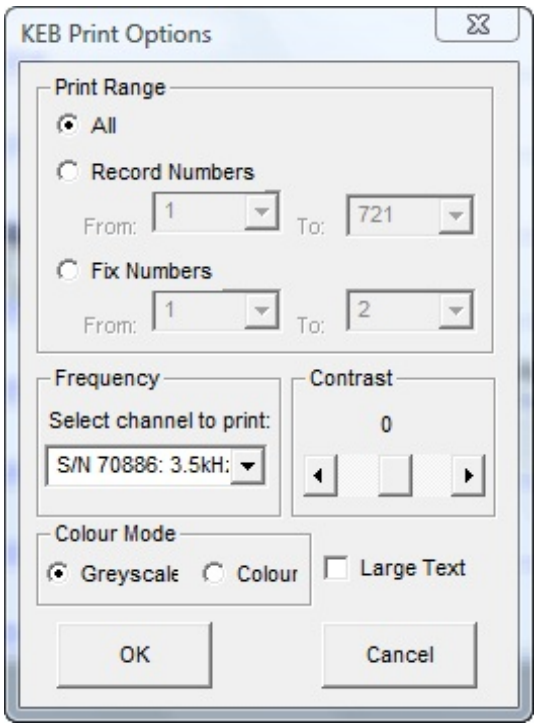
DATA INPUT = PARALLEL
SWEEP = FORWARD
SHADES = 064
DATA TYPE = 6BITS
WIDTH = 2048
LPI = 200 nominal (not EXTERNAL)

The **Port Addr** option allows the user to specified the proper output port address for the printer port. For most systems, this value should be 0378h, but for some laptops and secondary printer ports the alternate value of 0278h could be required.

The **Print Test Block** check box allows the user to tell the application to send some test data to the selected thermal recorder to confirm it is interfaced properly. The test block consists of greyscale ramps with samples of imbedded grid and fix annotation text.

The recorder selection and port address settings are stored in the application's registry keys and restored the next time the program is invoked.

3.10.2 Send Data



The Send Data menu option is used to print the entire file or selected portions for the currently active file. This option is not available if a data file is not already opened. When this item is selected, it first causes a dialog box to pop up that allows the user to select the presentational parameters desired. If the OK box is clicked, the application then brings up a status display dialog box indicating the progress of the print job in terms of pings printed relative to the total number in the data set. It also provides the user with the ability to cancel the print job if desired.

Note: this menu option is only used to send data to thermal recorders, not standard Windows printers. Use the Print command to print to standard Windows printers.

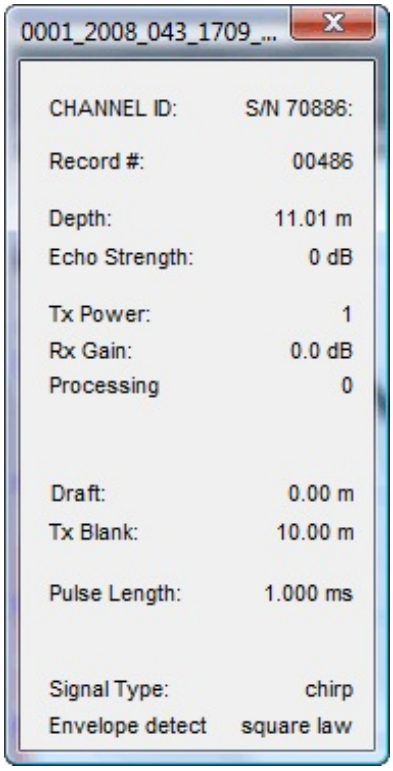
3.11 Exit

The user can terminate the PostSurvey program using the **Exit** command. Many configuration parameters are recorded as the program is terminated.

4 View

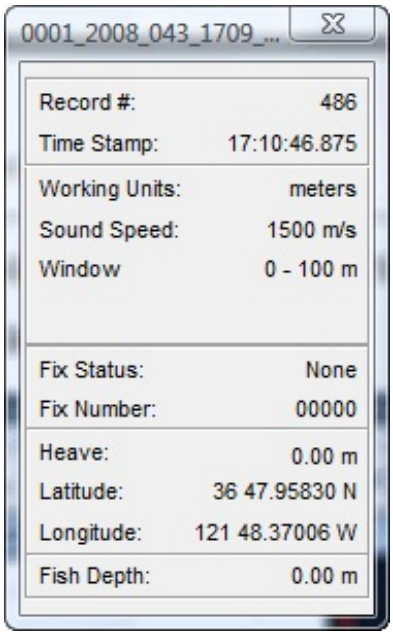
This control group provides access to data display dialogs and toolbar configuration controls. The echogram chart is only one of the items of interest during playback of the data set. Sometimes the user wishes to see what control settings were in use to achieve the echogram on display. The various dialogs accessible from this control group provides access for the user to this additional control information.

4.1 Channel Data



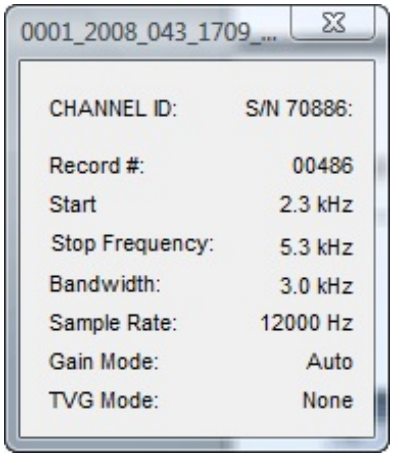
These Channel Data controls allow the user to display or close individual dialog boxes for each frequency channel. If the user clicks the left mouse button while pointing the cursor to a position of interest on the echogram display window, any active channel data dialog boxes will display the following data for the ping record represented by that point: record number assigned by the echosounder, the depth and echo strength determined by the echosounder's digitizer, and all of the transmit power, gain, draft, transmit blanking, pulse type and signal type settings used for that particular ping cycle.

4.2 Parameter Data



The Parameter Data option provides the user with the ability to display or close a dialog box that presents the non-channel specific data recorded from the echosounder. If the user clicks the left mouse button while pointing the cursor to a position of interest on the echogram display window, the active parameter data dialog box will display the following data for the ping record represented by that point: record number assigned by the echosounder, echosounder time stamp at start of the ping cycle, working units and speed of sound being used for calculations, upper and lower limits of the active window being displayed, fix status code and fix number if a fix condition exists, and the heave and position data used for the ping cycle.

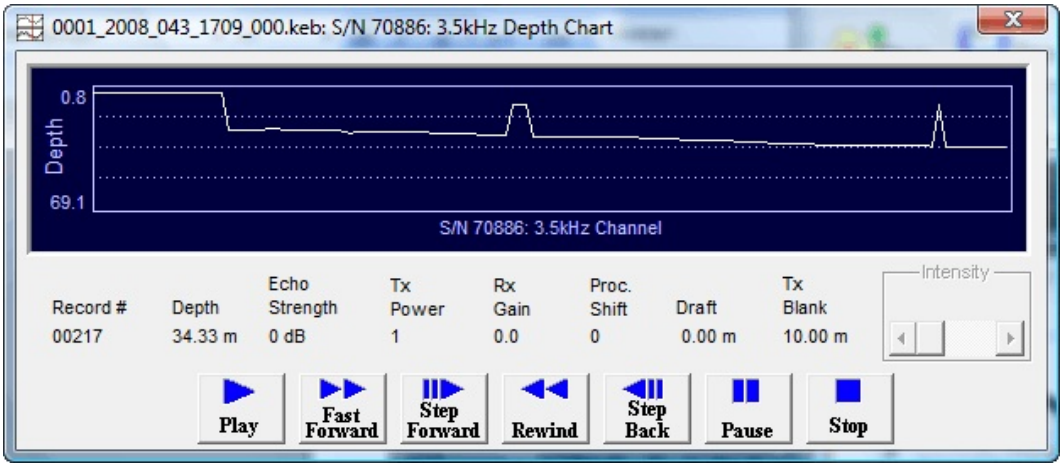
4.3 Signal Data



The Signal Data option provides the user with the ability to display or close a dialog box that presents the extended channel - specific and system data recorded from the echosounder. If the user clicks the left mouse button while pointing the cursor to a position of interest on the echogram display window, the active parameter data dialog box will display the following data for the ping record represented by that point: record number assigned by the echosounder, start and stop frequencies of the transmit pulse, bandwidth of the transmit pulse, sample rate used to digitize the echogram, analog gain mode, and TVG mode

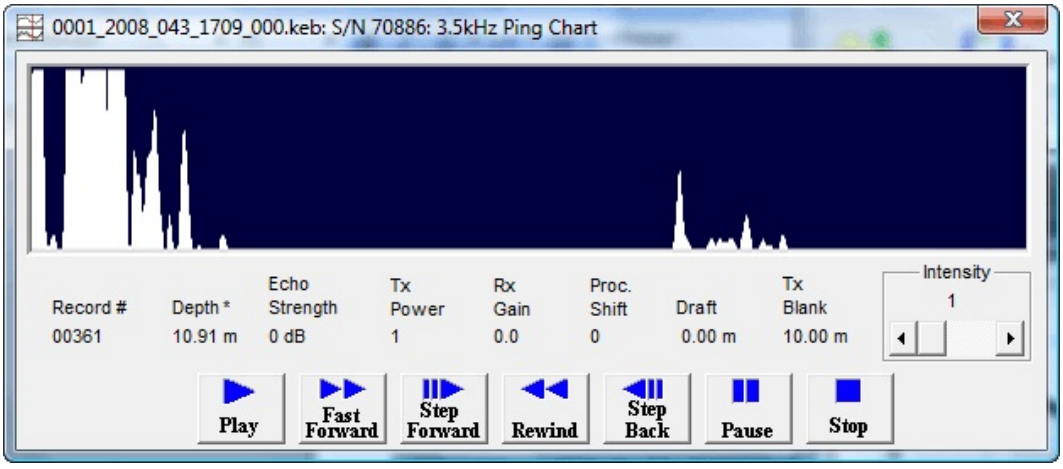
in use for the ping record.

4.4 Depth Chart



This option allows the user to view the digitized depth value for the entire data set in a simple line chart display. At the bottom of this chart are located many VCR like controls which allow the user various options for viewing the Digitized depth of the data set. Just under the display section of the graph is a parameter data section which displays the configuration parameters for the right most ping if playing forward through the file or the left most ping if playing backwards through the file. In order to close a particular chart you simply select the button that corresponds to the open chart along the Control Bar on the left side of the screen.

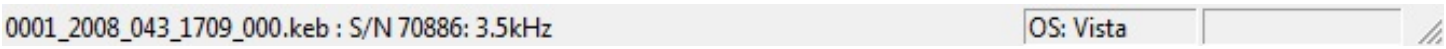
4.5 Ping Chart



The Ping Chart operates in much the same fashion as the Depth Chart, except the Ping Chart displays the intensity of each sample along an entire ping trace. To the right of the graph is an intensity slider control which will magnify the image in the display area by the factor displayed in the control. The VCR style controls operate in the same manner as those for the Depth Chart.

4.6 Status Bar

This control allows the user to enable and disable the application's status bar.



The status bar contains relevant information such as the name of the currently active line file in the left corner. The Windows Operating system is displayed in the box second from the right and the currently available thermal printer is displayed in the box furthest to the right

4.7 Main Toolbar

This control allows the user to enable and disable the application's Main tool bar.

The Main tool bar contains easy access controls which can also be found under the File Menu.

4.8 Info Toolbar

This control allows the user to enable and disable the application's Info tool bar.

The Info tool bar contains easy access controls which can also be found under the view menu.

4.9 Settings Toolbar

This control allows the user to enable and disable the application's Settings tool bar.

The Settings tool bar contains easy access controls which can also be found under the settings menu.

4.10 Channel Toolbar

This control allows the user to enable and disable the application's Channel toolbar.

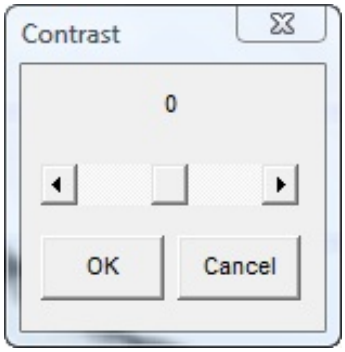
The Channel tool bar contains one button which allows the user to select the channel within the currently active data set that they would like to view. This tool bar is only active when more than one channel is recorded in the active data set.

4.11 Active Global Scroll

This control is a toggle that is only active if more than one channel is recorded in the currently active data set. Each channel in a given data set will be opened in a separate window. When the Active Global Scroll toggle is set it acts as a master scroll bar and will synchronize all open channel windows associated with the currently active data set.

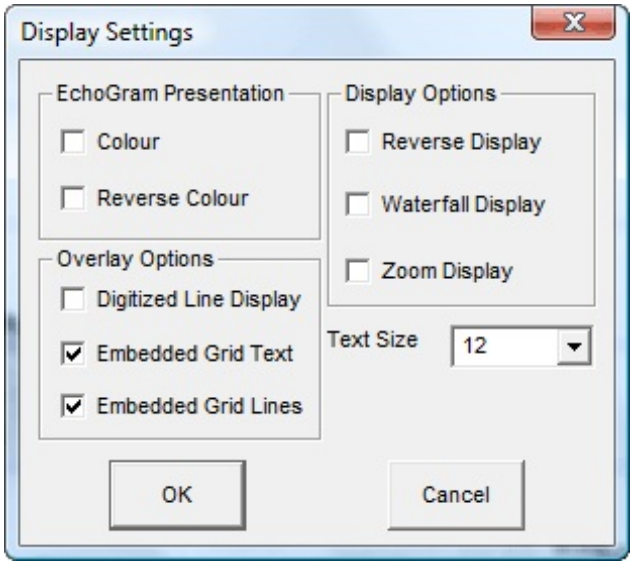
5 Settings

5.1 Contrast



This option pops up a dialog box with a single control that allows the user to increase/decrease the contrast of the displayed greyscale data.

5.2 Display



The **Display** option brings up a dialog box that allows the user to customize the display presentation to a configuration that suits his personal requirements.

5.2.1 Colour

When **Colour** mode is selected (box checked), the envelope data displayed in the program window is in 15 colour levels, mapped from lowest to highest levels as follows: White(normal video) or Black (reverse video), Light Grey, Dark Grey, Cyan, Blue, Dark Blue, Dark Cyan, Dark Green, Dark Yellow, Green, Yellow, Magenta, Dark Magenta, Red, Dark Red. If this item is not checked, the envelope data is displayed in levels of grey, where for normal video mode white is the lowest level return and black is the highest; for reverse video mode white is the highest level return and black is the lowest.

5.2.2 Reverse Colour

When **Reverse Colour** mode is selected, the display colours are configured to make black the main background colour. For both colour and greyscale modes, the lowest level return is assigned the colour black. When **Reverse Colour** is not selected (normal mode), the lowest level return is assigned the colour white.

5.2.3 Digitized Line Display

This control allows the user to display a red line over top of the echogram to indicate where the digitized depth was recorded along the trace. This control acts as a toggle to allow the user to switch the Digitized depth overlay on or off.

5.2.4 Embedded Grid Text

The **Embedded Grid Text** option allows the user to enable (box checked) or disable the use of embedded grid text. When this option is enabled, grid text is displayed within the envelope data display whenever a range or phase change occurs, or at evenly spaced intervals if no changes have occurred. The embedded text can be disabled for cases when the grid text changes obscure the envelope data.

5.2.5 Embedded Grid Lines

The **Embedded Grid Lines** option allows the user to enable (box checked) or disable the use of embedded grid lines. When this option is enabled, the chart grid is displayed within the envelope data . The embedded grid lines can be disabled for cases when it is undesirable such as bitmap creation for presentational purposes.

5.2.6 Reverse Display

This control will display the data set in Reverse View (last data sample displayed first). This control acts as a toggle to allow the user to switch back to Normal View (first data sample displayed first).

5.2.7 Waterfall Display

This control will display the data set along the y axis. This control works as a toggle to allow the user to switch back to standard view (display along the x axis).

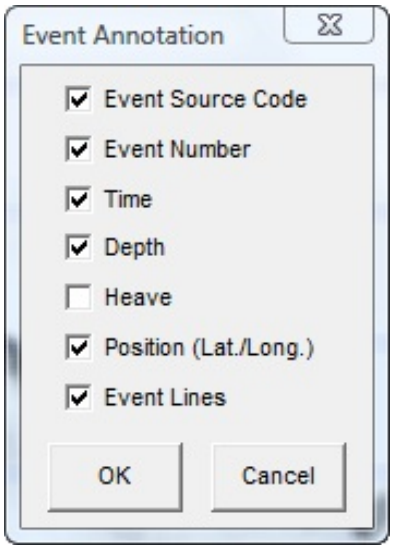
5.2.8 Zoom Display

This control is a primitive zoom control which will magnify the display by a factor of 2 along which every axis is currently active. This control acts as a toggle to allow the user the switch back to Regular view (1:1)

5.2.9 Text Size

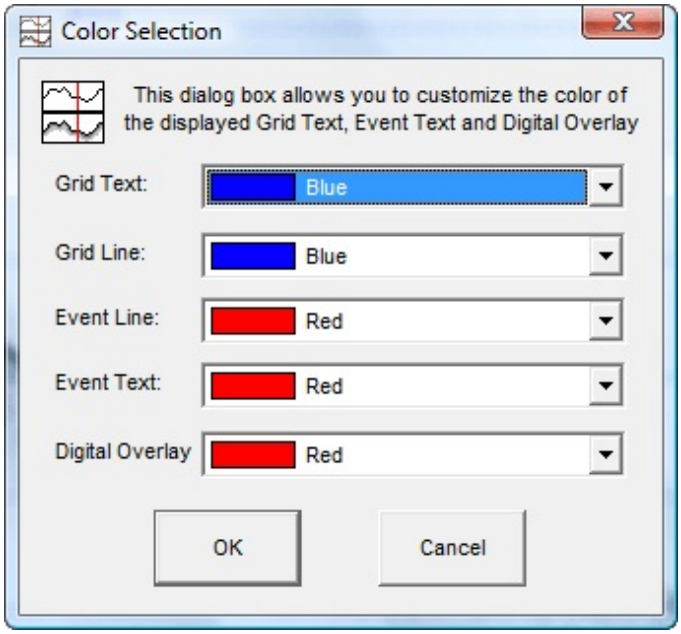
This option allows the user to select a preferred font size.

5.3 Event Annotation



This menu item brings up a dialog box that allows the user to select which of the available data parameters will be printed out on the event mark annotation line. The selections made here apply to the display, the Windows printer outputs, and the thermal recorder output. The user has no control on the ordering of the parameters; they are output in the order they are listed if they are checked off.

5.4 Colour Selection



The Colour Selection dialog box allows the user to customize the colour for select display components such as the grid, annotation text, and overlays.

5.5 Alternate Printer

This control is a toggle switch which was included for users having a problem printing to a select group of Windows printers. The default for this control is unchecked. If the grid data for the line file being printed is the only data that is displayed on a printout, then simply checking this control should resolve this problem.

6 Window

This control group is only visible when a valid data file is opened.. This Control group allows the user to easily arrange the multiple files and Windows they have open. At the bottom of this control group is a list of all open line files. When a line file from this list is selected it then becomes the active file within the display area of the application.

6.1 Cascade

This option will take all open windows and display them in a overlapped format down the display area of the application.

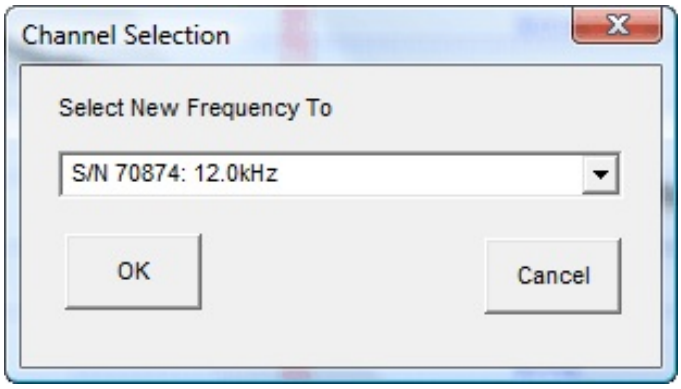
6.2 Tile

This option will take all open windows and stretch them across the width of the display area and stack them on top of one another.

6.3 Arrange Windows

This option will arrange all minimized file icons along the bottom of the display area within the application.

7 Channel

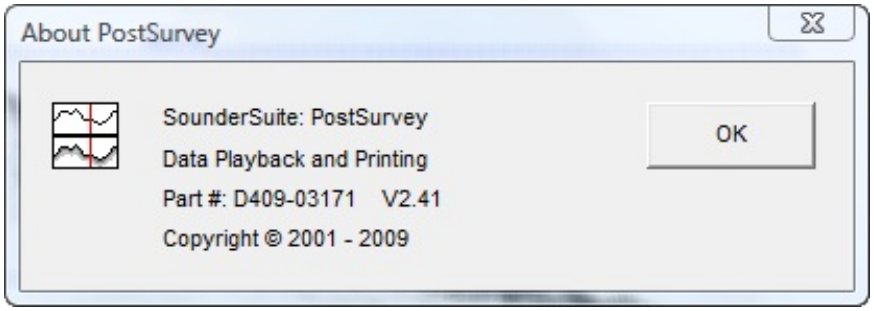


The Channel menu item, and similarly, the Channel tool bar button provide access to a control dialog used to activate additional channel windows for the currently active file set.

The Channel control is only active when more than one channel is recorded in the active data set.

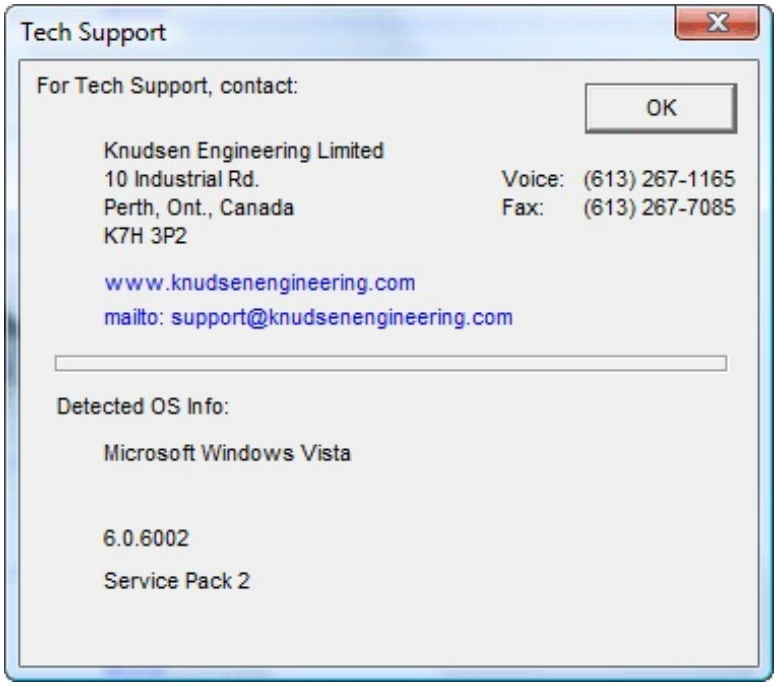
8 Help

8.1 About PostSurvey



The **About PostSurvey...** menu item brings up a simple dialog box stating the name of the PC software program, the KEL part number for the program, and the latest revision number.

8.2 Tech Support



This option brings up a simple dialog box that provides contact information for technical support. It also provides information about the type of Windows operating system the program has detected.

SounderSuite -USB

Firmware Loader

Supports Software: D409-04363

D101-04382
Revision 2.0
July 6, 2009

Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario, Canada

CONTENTS

1 INTRODUCTION. 1-1
1.1 About this manual. 1-1
1.2 Software Description. 1-1
1.3 Technical Support. 1-1

2 OPERATING INSTRUCTIONS. 2-1
2.1 Description. 2-1
2.2 System. 2-2
2.2.1 Scan for Devices. 2-2
2.2.2 Exit. 2-2
2.3 View. 2-2
2.3.1 Load DSP Firmware. 2-2
2.3.2 Load CFG Update. 2-6
2.3.3 Load Printer Firmware. 2-9
2.4 Help. 2-12
2.4.1 Sounder Info. 2-12
2.4.2 Tech Support. 2-14
2.4.3 About FirmwareLoader.... 2-14

1 INTRODUCTION

1.1 About this manual

This manual provides information about the Firmware Loader application, D409-04363, FirmwareLoader.exe. This program has been designed to support in-field firmware upgrades of the internal modules of Knudsen Engineering Limited's USB Echosounders. For detailed instructions on the upgrade process, please see document reference D101-04383: Windows Installation and Firmware Upgrades.

1.2 Software Description

The Firmware Loader allows the user in the field to upgrade the firmware in his unit's channel DSP modules and printer module (if one is present). This application provides the user access to controls to program the firmware with new releases from the factory for overall operational enhancements. Additionally, it allows the user to program configuration information supplied by the factory and granted to licenced users.

1.3 Technical Support

For technical support or to report problems please contact your local representative or:

Technical Support
Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario
K7H 3P2

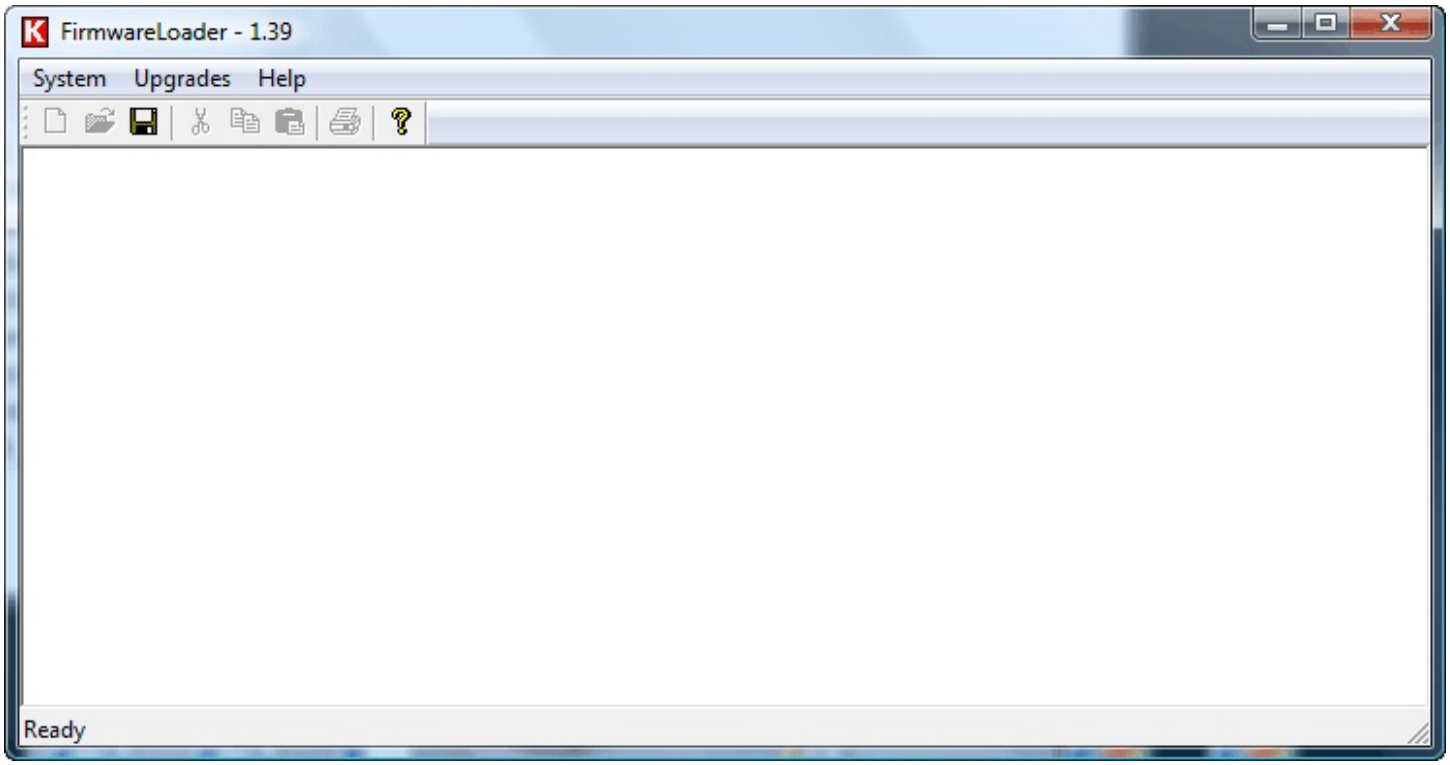
Voice: (613) 267-1165 8:30 am to 5:00 pm E.S.T. Core Hours
Fax: (613) 267-7085
E-Mail: support@knudsenengineering.com
WebSite: http://knudsenengineering.com/

2 OPERATING INSTRUCTIONS

2.1 Description

When the Firmware Loader application is run, it scans the USB bus for supported DSP and printer modules. Note: for this to work reliably, the EchoControl Server application should be terminated before the Firmware Loader is run. Additionally, to ensure the modules are in the appropriate state to support programming, the sounder should be powered off, and then back on before the Firmware Loader is activated.

Once the bus scan is complete, the Firmware Loader displays a simple window with a menu system to access key controls for the upgrade process. Please see document reference D101-04383: Windows Installation and Firmware Upgrades for detailed instructions on the upgrade process.



2.2 System

2.2.1 Scan for Devices

Sometimes on start-up, the Firmware Loader may not see any DSP or printer modules on the bus. For example, if they are not connected or are powered off. This command gives the user the opportunity to rescan the bus after correcting the source of the problem without having to restart the application. This option is only enabled if no supported modules are detected on the USB bus. If any supported modules are detected, this option is disabled.

2.2.2 Exit

The user can terminate the FirmwareLoader application using the **Exit** command.

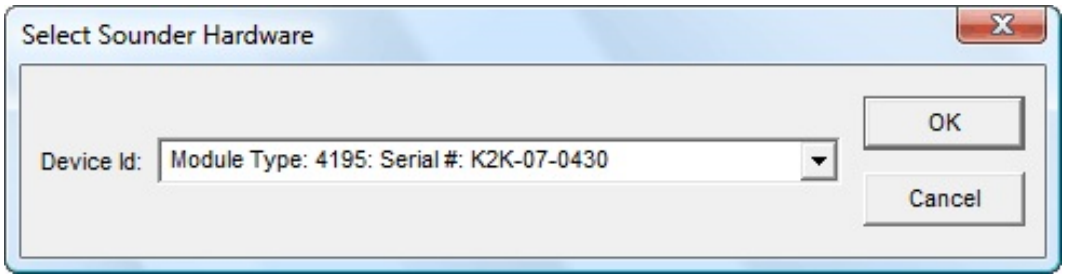
2.3 View

This control group allows access to the key functions used for the in-field firmware upgrades. The first two menu items are for upgrading and configuring the DSP channel modules; the last item is for upgrading the printer module.

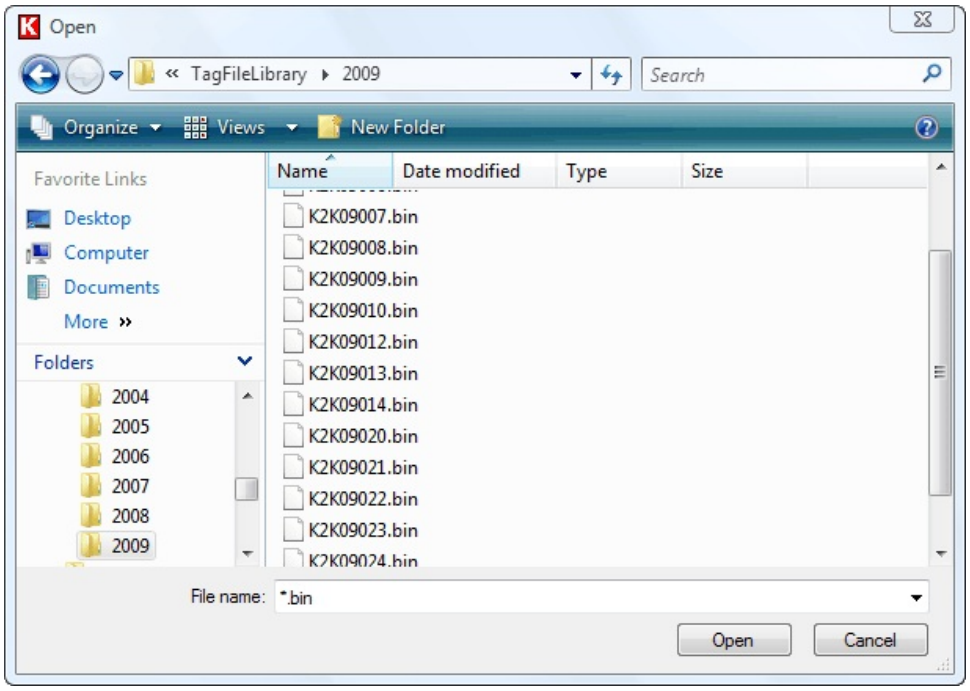
2.3.1 Load DSP Firmware

The Load DSP Firmware command is used to start the firmware upgrade of a DSP channel module. If there are no DSP modules detected, then this menu item will be disabled.

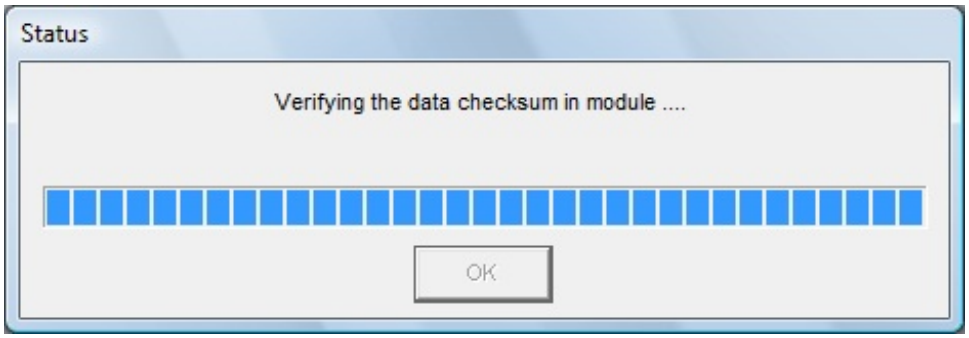
If only one module is detected on the USB bus, the user is taken straight to the dialog to open the desired .bin file. If more than one is detected, then a dialog box with a drop-list is opened to allow the user to select which module should be updated.



Once the user has selected and accepted a module to update, a File Open dialog will appear. This dialog allows the user to navigate to the folder where the necessary firmware file, typically a .bin file, is located. The user then selects the desired firmware file and clicks the Open button to load it.



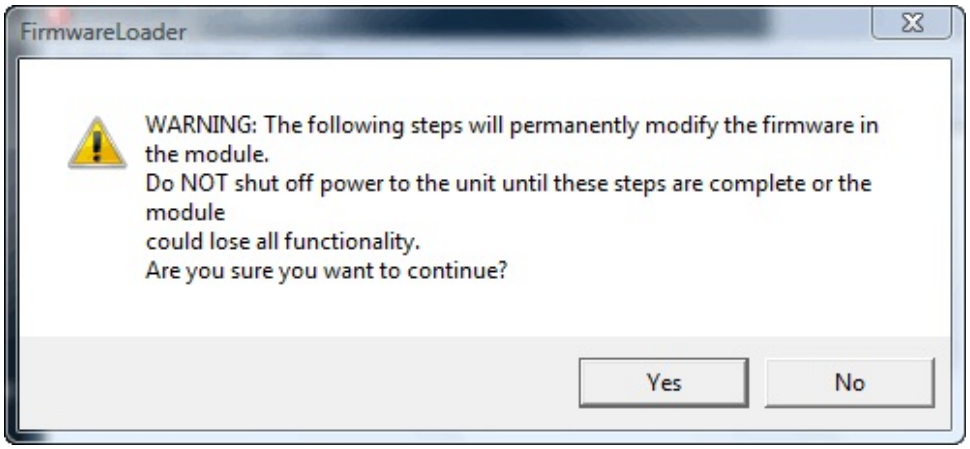
This starts the upgrade process by transferring the firmware to the DSP module. It then does a checksum test to ensure the data transferred to the module was received correctly.



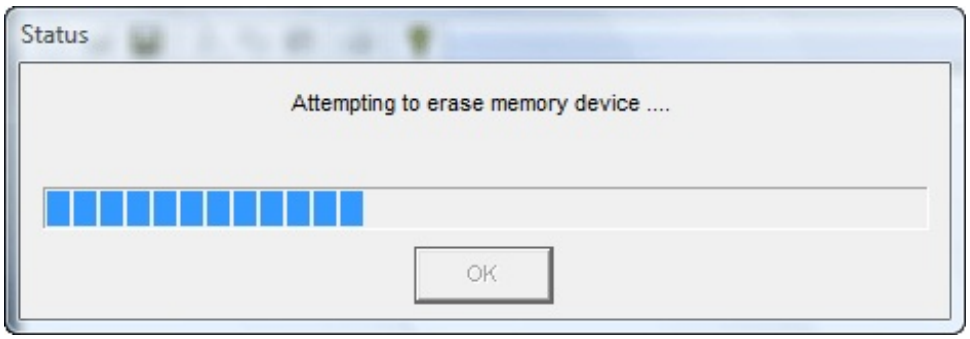
If not, a warning message appears indicating the checksum failure, and the upgrade is aborted.

Checksum failures could be a result of USB bus changes that occurred after the Firmware Loader was started, especially if additional DSP modules were detected. The thing to do in this case is to shutdown Firmware Loader, power off the sounder, power on the sounder and wait a few seconds to allow Windows to detect the internal modules. Then restart Firmware Loader and re-attempt the update.

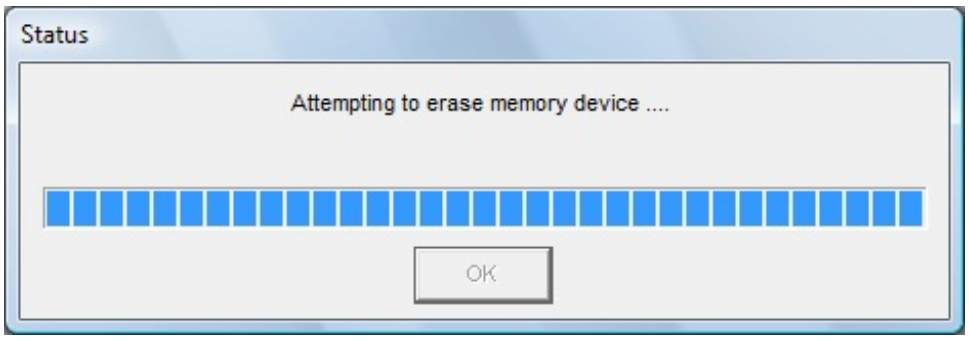
Otherwise, if the checksum tested passed successfully, the application will prompt the user with a confirmation message box. This is to warn the user that as soon as they accept this action, they will permanently change the code in the module. Normally this is what is desired, so the user should simply accept the prompt to continue.

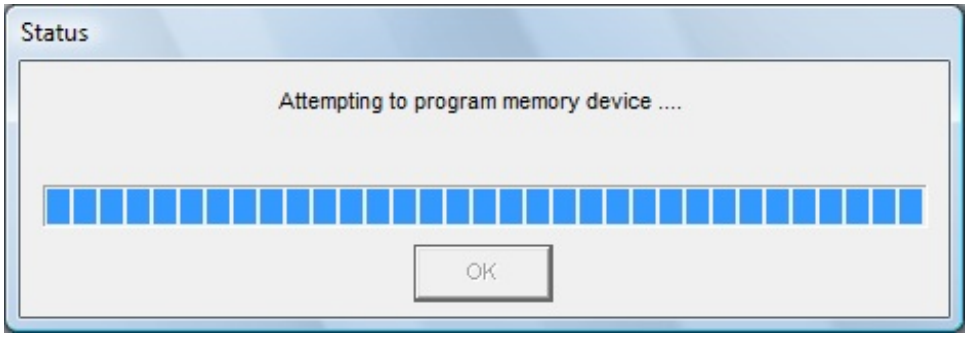


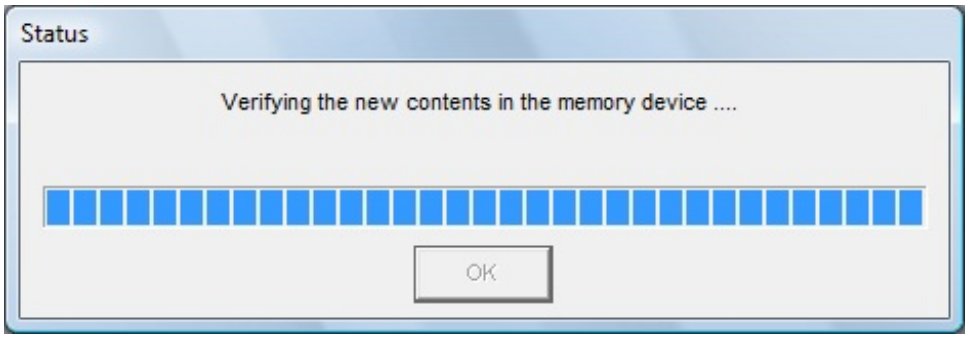
The actual programming steps can take a little while, so a progress bar continues to update the status as the various stages are run on the embedded module.



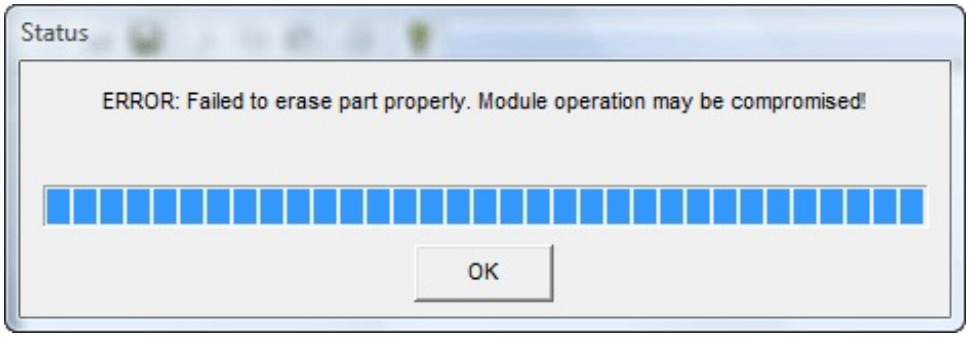
During this programming process, at various key points, the application checks for error conditions.



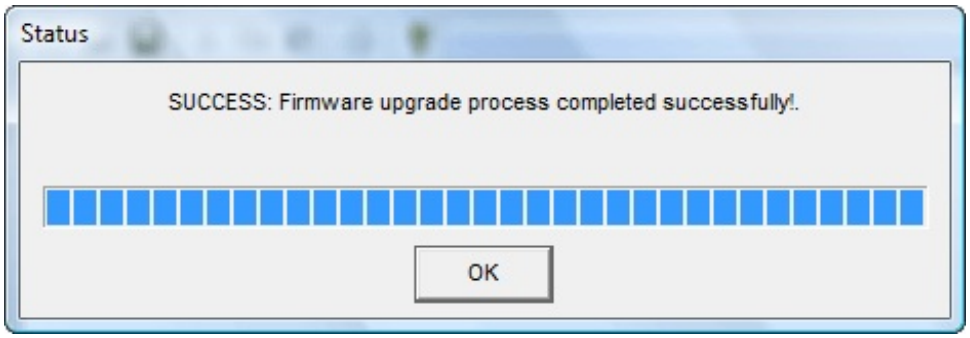




If any error is detected, the progress dialog will terminate with the appropriate error message such as “failure to erase” or similar. These types of errors are typically a result of the module not being in the appropriate start-up state to support programming. Simply exiting the Firmware Loader, power cycling the sounder and then retrying the update steps should resolve these errors.



If the operation has completed successfully, the progress dialog with terminate with a message indicating the successful completion.

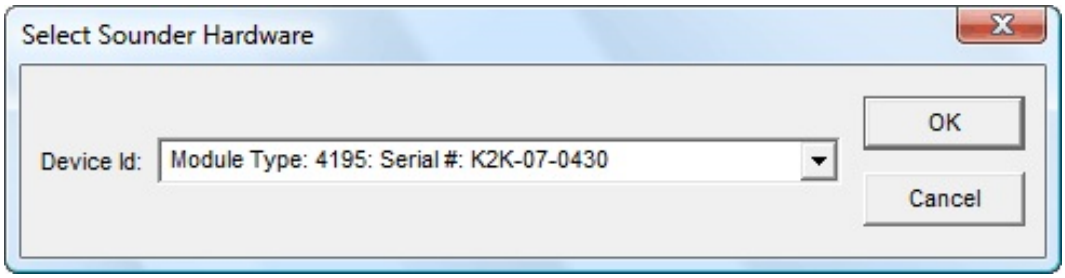


N.B.: At this time, the new firmware is programmed into the DSP module but it is not actually running yet. The sounder will need to be power-cycled for the new firmware to become active.

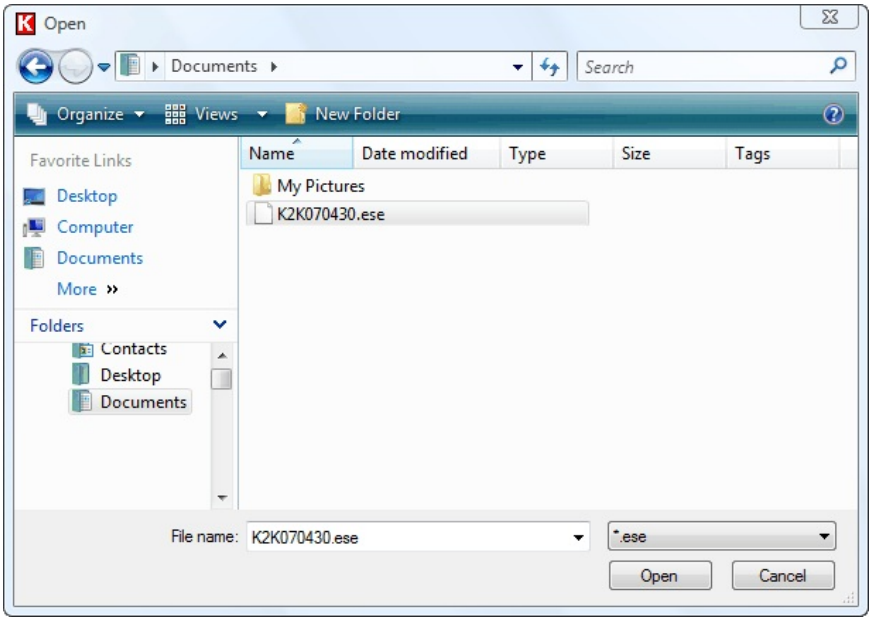
2.3.2 Load CFG Update

The Load CFG Update command is used to start the process for programming new feature configurations into a DSP channel module. If there are no DSP modules detected, then this menu item will be disabled.

If only one module is detected on the USB bus, the user is taken straight to the dialog to open the desired .ese file. If more than one is detected, then a dialog box with a drop-list is opened to allow the user to select which module should be updated.

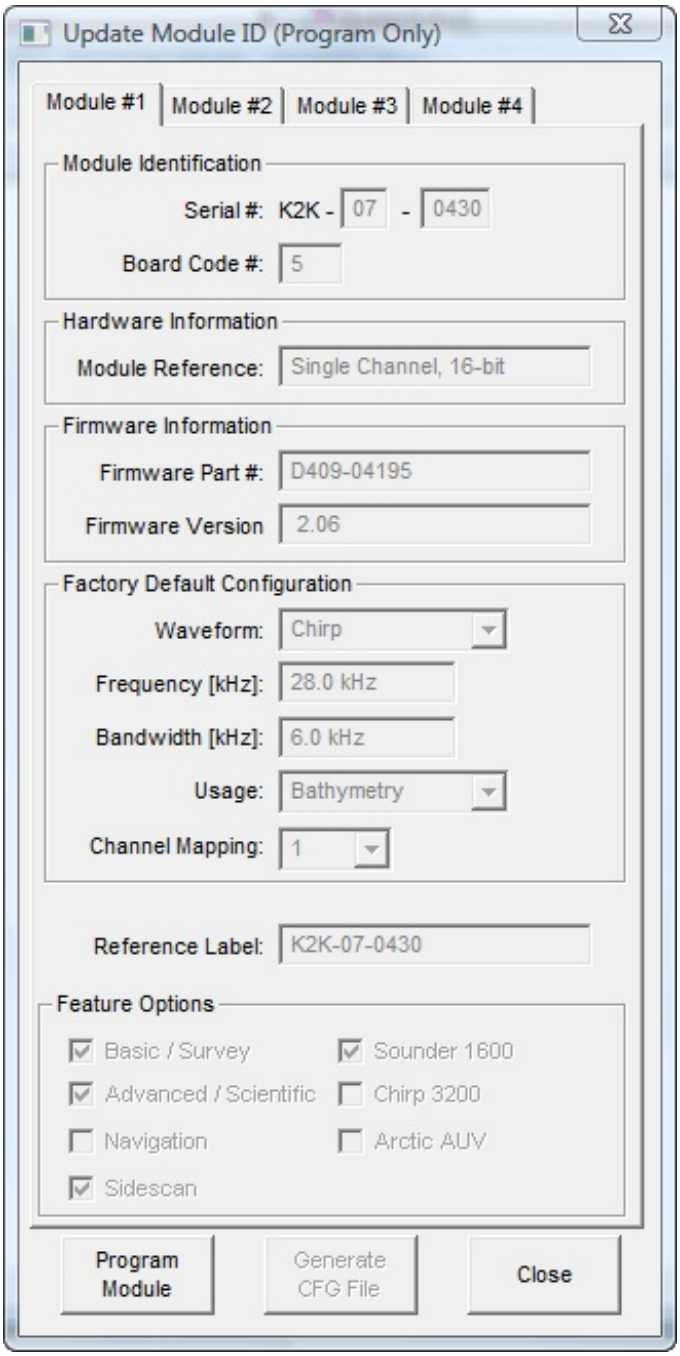


Once the user has selected and accepted a module to update, the File Open dialog appears allowing the user to navigate to the folder where the necessary configuration file, typically an .ese file, is located.



The user selects the desired configuration file and clicks on Open to load it.

This causes an Update Module ID dialog to appear. Normally the .ese file is specific to a particular DSP module and they are matched using the module's Serial #. This dialog allows the user to verify he is actually modifying the DSP module that is really required, and that it enables the features he is expecting for his system. Some features are unit type specific, some are special order items.



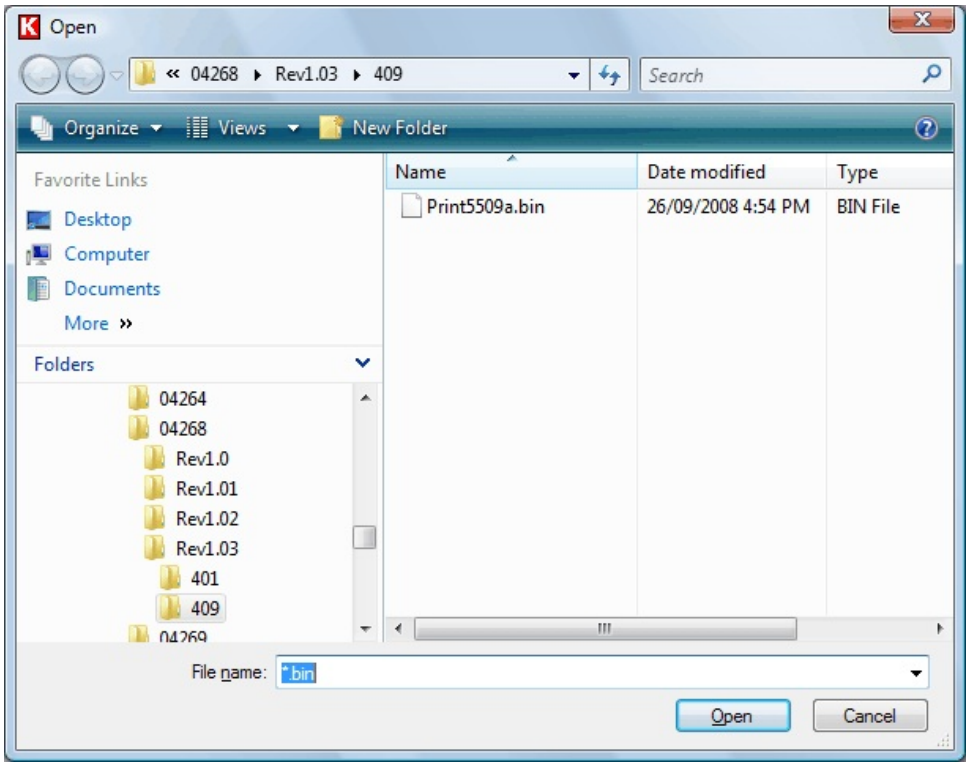
If the module identification is correct, the user simply clicks the Program Module button to program the setup permanently into the module. There is no specific feedback about the progress; the dialog simply disappears briefly until the task is complete, then reappears with the info loaded into the module.

The sounder will need to be power-cycled for the changes to become active.

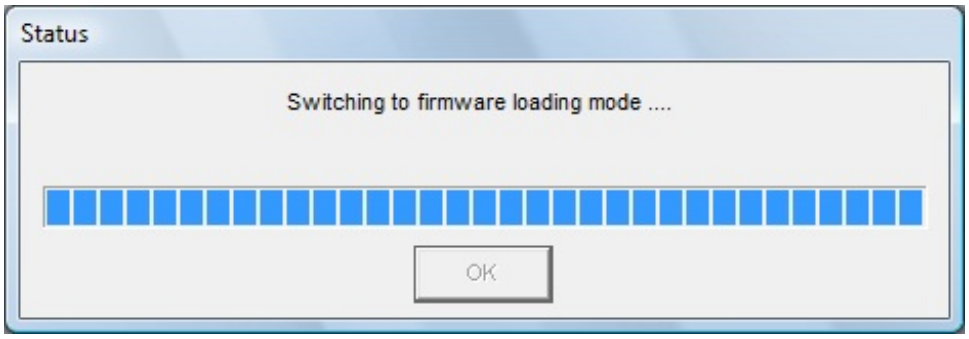
2.3.3 Load Printer Firmware

The Load Printer Firmware command is used to start the firmware upgrade of a Printer module. If there are no Printer modules detected, then this menu item will be disabled.

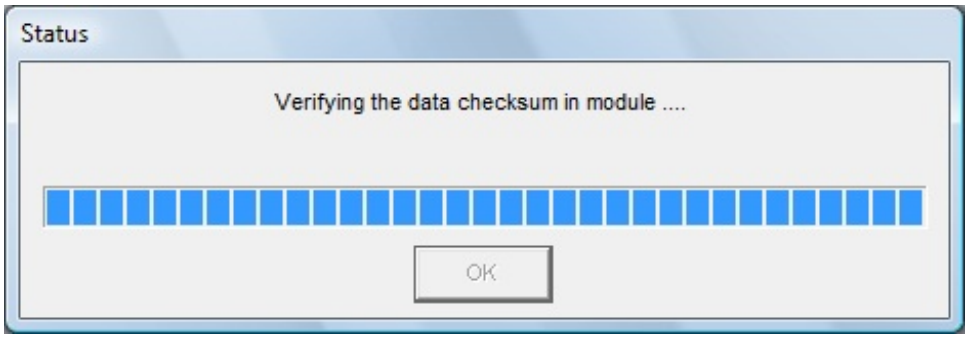
When the user selects this option, a File Open dialog appears allowing the user to navigate to the folder where the necessary firmware file, typically a .bin file, is located. The user selects the desired firmware file and clicks on Open to load it.



This starts the upgrade process by transferring the firmware to the DSP module.



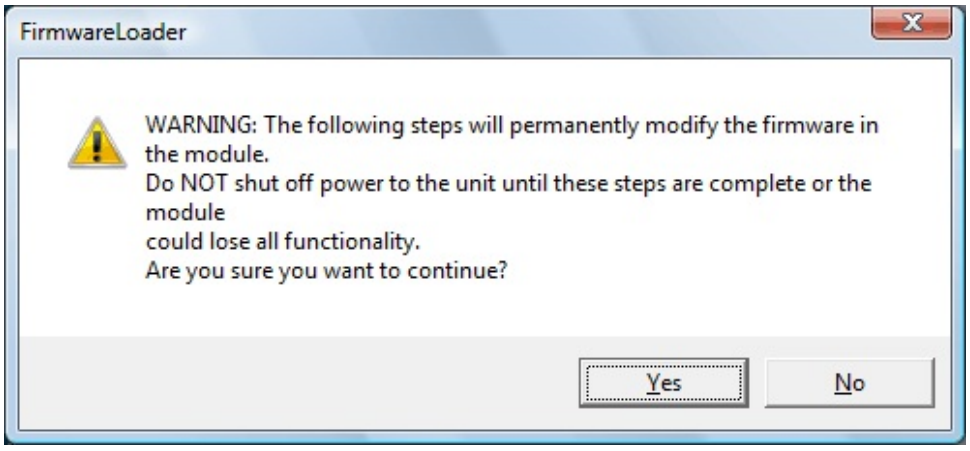
It then does a checksum test to ensure the data was transferred to the module correctly.



If not, a warning message appears indicating the checksum failure.

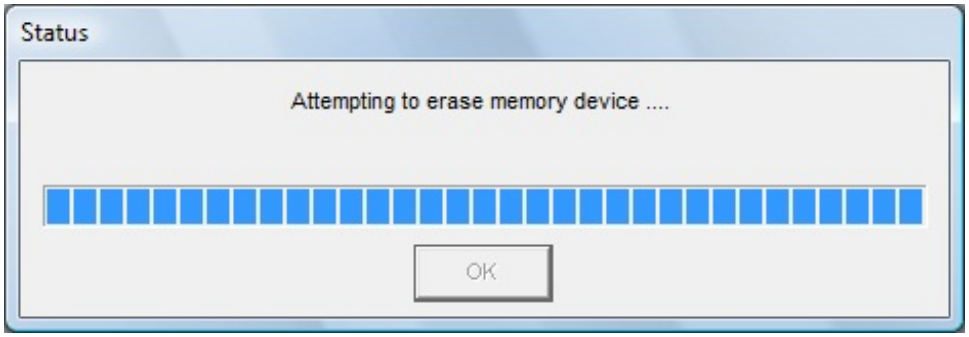
Checksum failures could be a result of USB bus changes that occurred after the Firmware Loader was started, especially if additional DSP modules were detected. The thing to do in this case is shutdown Firmware Loader, power off the sounder, power on the sounder and wait a few seconds to allow Windows to detect the internal modules. Then restart Firmware Loader and re-attempt the update.

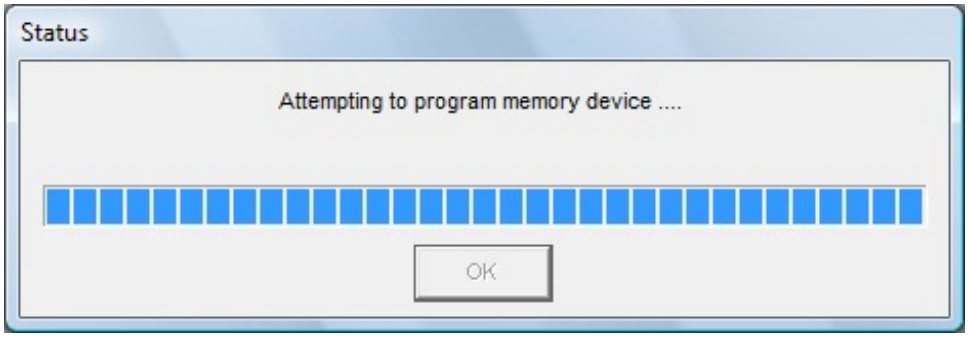
Otherwise, if the checksum tested passed successfully, the application will prompt the user with a confirmation message box. This is to warn the user that as soon as they accept this action, they will permanently change the code in the module. Normally this is what is desired, so the user should simply accept the prompt to continue.

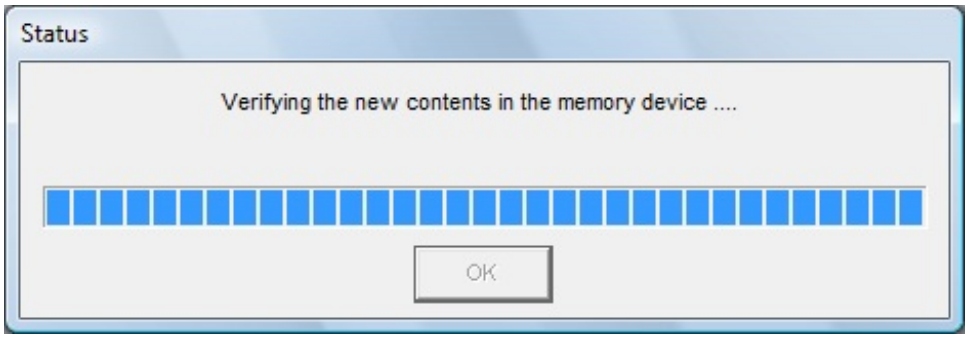


The actual programming steps can take a little while so a progress bar continues to update the status as the various stages are run on the embedded module.

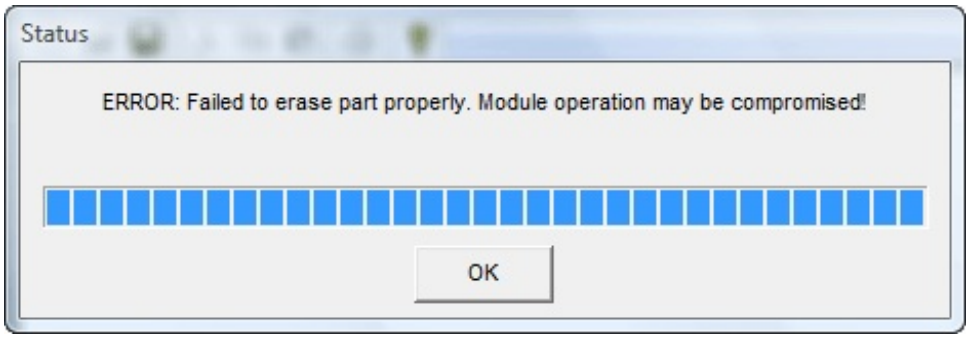
During this programming process, at various key points, the application checks for error conditions.



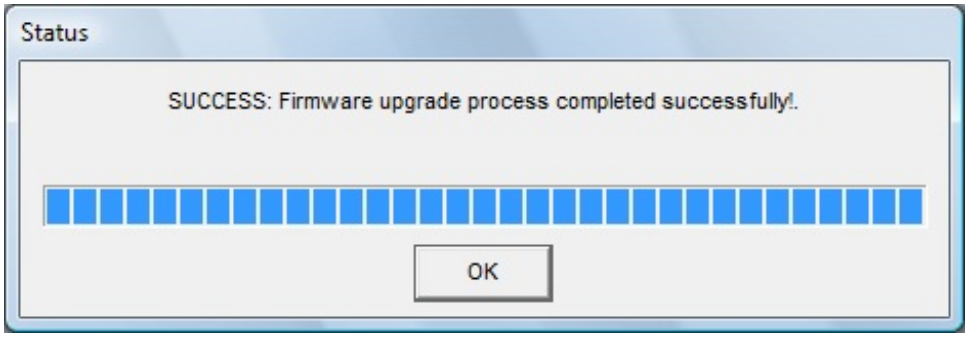




If any error is detected, the progress dialog will terminate with the appropriate error message such as “failure to erase” or similar. These types of errors are typically a result of the module not being in the appropriate start-up state to support programming. Simply exiting the Firmware Loader, power cycling the sounder and then retrying the update steps should resolve these errors.



If the operation has completed successfully, the progress dialog will terminate with a message indicating the successful completion.



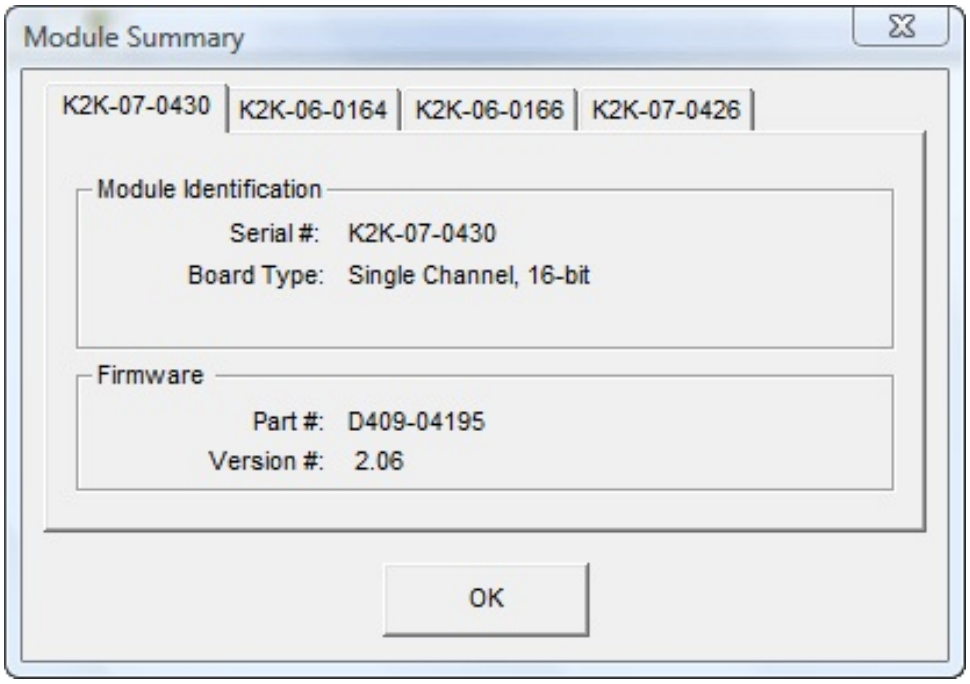
N.B.: At this time, the new firmware is programmed into the DSP module but it is not actually running yet. The sounder will need to be power-cycled for the new firmware to become active.

2.4 Help

The **Help** menu provides access to system configuration information that is most useful when contacting the factory for technical assistance. There are no other help features implemented at this time.

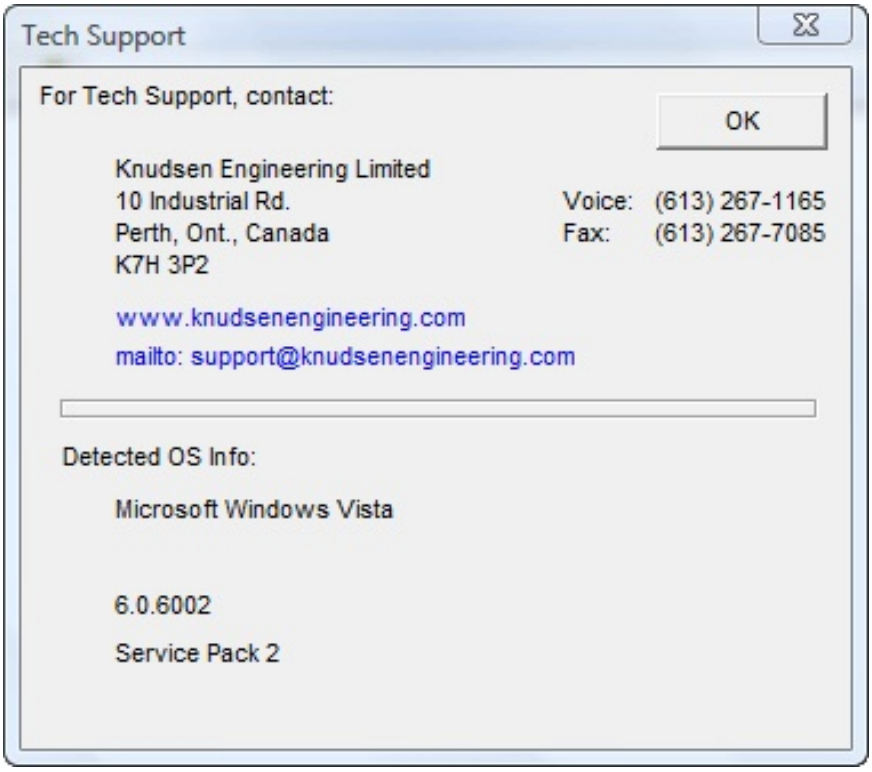
2.4.1 Sounder Info

This option pops up the Module Summary dialog box used for summarizing the channel modules detected by the server.



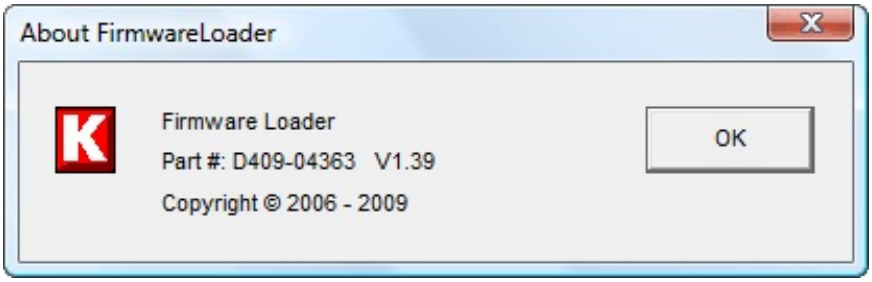
The Module Summary dialog provides information regarding the hardware channels detected in the sounder by the Firmware Loader application. For each hardware module, it reports the programmed serial number, the module's type, plus the firmware part number and version. This is a useful reference for verifying the hardware status in the sounder.

2.4.2 Tech Support



This option brings up a simple dialog box that provides contact information for technical support. It also provides information about the type of Windows operating system the Firmware Loader program has detected.

2.4.3 About FirmwareLoader...



The **About FirmwareLoader...** menu item brings up a simple dialog box stating the name of the PC software program, the KEL part number for the program, and the latest revision number.

SounderSuite -USB

Conversion Utility

Supports Software: D409-04545

D101-04968
Revision 1.1
December 22, 2010

Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario, Canada

CONTENTS

1 INTRODUCTION. 1-1
1.1 About this manual. 1-1
1.2 Software Description. 1-1
1.3 Technical Support. 1-1

2 OPERATING INSTRUCTIONS. 2-1
2.1 Description. 2-1
2.2 Select Source File. 2-1

1 INTRODUCTION

1.1 About this manual

This manual provides information about the Conversion Utility application, D409-04545, ComversionUtility.exe. This program has been designed to give the user the ability to convert between supported data file types.

1.2 Software Description

The echosounder control software is capable recording various data formats in real time. Sometimes, a user may decide not to record a particular format type during his real-time survey operation and then realize after the fact he needs that particular data type for his post-processing or his client's deliverables. The Conversion Utility provides the user the ability to create a file of the given type from a file of another type that was recorded in real-time. The conversion process is not the ideal method for generating some format types since the source file used may be lacking some information that would have been available during real-time recording but the Conversion Utility will populate as many fields as technically possible with what data is available.

The Conversion Utility also allows the user to convert older formats of KEB binary files for readback in the PostSurvey application.

1.3 Technical Support

For technical support or to report problems please contact your local representative or:

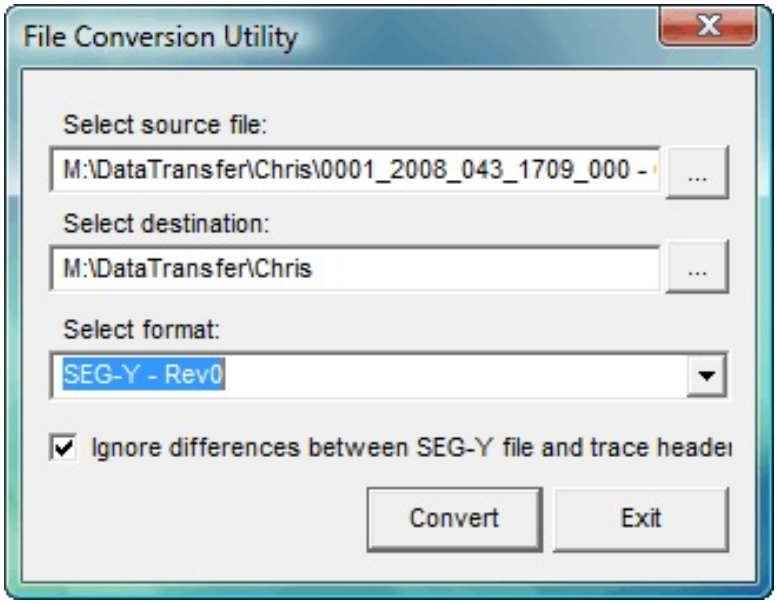
Technical Support
Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario
K7H 3P2

Voice: (613) 267-1165 8:30 am to 5:00 pm E.S.T. Core Hours
Fax: (613) 267-7085
E-Mail: support@knudsenengineering.com
WebSite: http://knudsenengineering.com/

2 OPERATING INSTRUCTIONS

2.1 Description

Then Conversion Utility application is a very basic application intended for simply converting one data file type to another data file type. When the user runs the application, a simple dialog box appears with the key controls needed to select source files, destination folder, and output file format.



2.2 Select Source File

The first item in the dialog is the selection entry for the file or files to be converted. The user can type in a file path and name explicitly, or click on the button at the right of the text entry to pull up a File Open dialog. In this dialog, the user can filter what type of files to view:

- Supported File Types (*.keb, *.sgy)
- SEG-Y Files (*.sgy)
- Knudsen Binary Files (*.keb)
- All Files (*.*)

The dialog supports the selection of multiple files; the application can handle up to 200 files in one batch session. Multiple input file formats can be supported; the application will run a detection algorithm on each file prior to starting the conversion on that particular input file.

- Select Destination

The next item in the dialog is the destination location. The user can simply type in a path and file name root or click the button on the right of the text entry to pull up a Save As dialog. By default, the filename is preloaded with <UseNameRoot>. This is required for doing batch jobs to make the application use the source file's name to construct the name for the new converted file. For single file conversions, the user can enter any name root they prefer.

- Select Format

The final item that needs to be set before the conversion operation can be run is to select the file type to be created by the conversion action. The available options for file types are:

SEG-Y - Rev0	(See D101-03021: KEL SEGY Format Usage Definition for details)
SEG-Y - KEL Extended	
XTF	(See D101-03322: KEL XTF Format Usage Definition for details)
KEA	
KEB - Compressed	(See D101-04842: File Format Specification KEB - D3 Format for details)
KEB - Uncompressed	

Only one output data type can be selected. If more than one type is desired, the conversion process needs to be run for each type to be converted.

If a SEG-Y format option is selected, an additional checkbox control is supplied to the user. This control allows the user to select if they would like to ignore any differences between fields in the main file header and the individual trace headers or if they want the application to open a new file each time a difference is detected.

File Format Specification

KEB - E0 Format

D101-05498
Revision 1.0
October 2, 2012

Knudsen Engineering Limited
10 Industrial Road
Perth, Ontario, Canada

CONTENTS

1 File Specification. 1-3
1.1 Overview. 1-3
1.2 File Type Id Preamble. 1-3
1.3 Record Preamble. 1-4
1.4 Ping Record: Record Type E0: Variable Length Multiple Channel Envelope. 1-4
1.5 Event Mark Code Definitions. 1-9

LIST OF TABLES

Table 1.1: Record Preamble. 1-4
Table 1.2: Ping Record - Uncompressed. 1-4
Table 1.3: Event Mark Codes. 1-9

1 File Specification

1.1 Overview

The envelope data for each channel can be recorded in a binary data file for use by post-processing software. Every ping cycle, one record is stored with header information and raw data for each frequency channel. Each record is variable in length with a current maximum possible number of 6772 bytes, and can be compressed using a Huffman compression algorithm. The storage device for these files should have sufficient disk space free to store the vast amounts of data generated, especially when working in shallow water where the faster ping rate results in a larger volume of data being generated.

The binary data files are recorded using the following basic structural format:

File Type Id Preamble	(40 bytes)
Record Preamble 1	(10 bytes)
Ping Record 1	(variable number of bytes, compressed if Huffman)
Record Preamble21	(10 bytes)
Ping Record 2	(variable number of bytes, compressed if Huffman)
Record Preamble31	(10 bytes)
Ping Record 3	(variable number of bytes, compressed if Huffman)
.	
.	
.	
Record Preamble N	(10 bytes)
Ping Record N	(variable number of bytes, compressed if Huffman)

The recording program will write data records to one file for up to 20000 pings, then the current file will be closed and a new one will be opened for subsequent data recording.

1.2 File Type Id Preamble

The first 40 bytes of the file are used for a file type identification preamble for the playback software to use. This is used to determine if the file is in the valid format supported by the version of software being used.

Example:

KEB D409-04184 V1.00 Huffman
(pad unused character locations with spaces)

where, KEB identifies the file as a KEL Binary file,
D409-04184 identifies the part number of the program used to record/convert the data,
V1.00 identifies the version of the program used to record/convert the data.
Huffman indicates that the data is in a compressed format (not present for uncompressed files)

After the File Type Id Preamble, the actual data records are stored as they are received. As soon as a record is received, it is recorded to the disk file. Records are recorded to the file in the same order as they were received (time stamps must be in sequential order). Multiple types of records can be stored in the binary file; ie Envelope data records, serial port sensor data records, configuration records, etc (only Envelope records are actually implemented at this time). The original data record format is shown in Table 1.2. The data can be stored in this format, or the user can enable data compression. When compression is enabled, each data record as shown in Table 1.2 has a Huffman compression algorithm applied to it. The result of the compression is stored in the file. The playback application runs the matching decompression algorithm to access the data records.

1.3 Record Preamble

Each data record is preceded by a Record Preamble that provides quick access, particularly for compressed records, to useful info about the record. This data is used by the PostSurvey application for faster analysis of the data statistics. See the following description about the Data Records for some of the field definitions.

Table 1.1: Record Preamble

FIELD DESCRIPTION	DATA TYPE	BYTE COUNT
Record Type Code	BYTE	1
File offset to start of record after the record preamble	long	4
Record Size expressed in bytes	long	4
Event mark code	BYTE	1
Byte Total		10

1.4 Ping Record: Record Type E0: Variable Length Multiple Channel Envelope

Table 1.2: Ping Record - Uncompressed

FIELD DESCRIPTION	DATA FORMAT / RANGE	Data Type	BYTE COUNT	BYTE OFFSET
Record Identification Information				
Record Id	E0h	WORD	2	0000h
Record Length	data dependent	DWORD	4	0002h
Record Number	0 to 65536	WORD	2	0006h
# of Channel Records	1 to 8	WORD	2	0008h
Reserved Bytes	NULL	WORD	20	000Ah
		Byte Count: Section Total	30	
Record TimeStamp				
Day	1 to 31	WORD	2	001Eh
Month	1 to 12	WORD	2	0020h
Year	yyyy	WORD	2	0022h
Hour	0 to 23	WORD	2	0024h
Minute	0 to 59	WORD	2	0026h
Seconds	0 to 59	WORD	2	0028h
Milliseconds	0 to 999	WORD	2	002Ah
Julian Day	1 to 365	WORD	2	002Ch
TimeTagSeconds	Seconds since midnight Jan 1, 1970	DWORD	4	002Eh
TimeTagMilliseconds	Millisecond portion of timetag	DWORD	4	0032h
FrameCountAtPingStart		DWORD	4	0036h

FIELD DESCRIPTION	DATA FORMAT / RANGE	Data Type	BYTE COUNT	BYTE OFFSET
FrameCountAtStorage		DWORD	4	003Ah
Reserved Bytes	NULL	WORD	20	003Eh
		Byte Count: Section Total	52	
Sounder Parameters Shared for Each Channel				
Working Units Code	0 = metres 1 = feet 2 = fathoms	WORD	2	0052h
Speed of sound	1300 to 1700 m/s 4265 to 5577 ft/s 710 to 929 fm/s	WORD	2	0054h
Pinger Mode (3200 series only)	0 = off, 1 = 1/8th second sweep 2 = 1/4th second sweep 3 = 1/2th second sweep 4 = 1 second sweep 5 = 2 second sweep 6 = 4 second sweep	WORD	2	0056h
Mux Enable (sweep systems only)	not currently in use	WORD	2	0058h
Mux Transducer Number (sweep systems only)	not currently in use	WORD	2	005Ah
Echogram Heave Compensation Flag	0 = echogram not heave compensated 1 = echogram heave compensated	WORD	2	005Ch
Number Of Pings	# pings active in Multiple Pings mode	WORD	2	005Eh
Sync Mode	0 = intternal sync 1 = external sync	WORD	2	0060h
Tracking Gate Width (expressed in working units)	0 to 200	WORD	2	0062h
Reserved Bytes	NULL	WORD	20	0064h
		Byte Count: Section Total	38	
Sensor Data Parameters Shared for Each Channel				
Heave (expressed in m, feet, or fathoms)	data dependent	float	4	0078h
Roll Angle [degrees]	data dependent	float	4	007Ch
Pitch Angle [degrees]	data dependent	float	4	0080h
Heading Angle [degrees]	data dependent	float	4	0084h
HeaveTimeTagSeconds	Seconds since midnight Jan 1, 1970	DWORD	4	0088h
HeaveTimeTagMilliseconds	Millisecond portion of timetag	DWORD	4	008Ch
Heave Sensor Quality	0 = invalid 1 = okay	WORD	2	0090h

FIELD DESCRIPTION	DATA FORMAT / RANGE	Data Type	BYTE COUNT	BYTE OFFSET
Position Format - Lat/Long or X/Y	0 = undefined format 1 = Latitude/Longitude 2 = X/Y	WORD	2	0092h
Latitude (expressed in degrees) or Y (from Hypack or GPS)	data dependent	double	8	0094h
Longitude (expressed in degrees) or X (from Hypack or GPS)	data dependent	double	8	009Ch
PosTimeTagSeconds	Seconds since midnight Jan 1, 1970	DWORD	4	00A4h
PosTimeTagMillieconds	Millisecond portion of timetag	DWORD	4	00A8h
Boat Speed (from Hypack or GPS)	tbd	float	4	00ACh
Boat Heading (from Hypack or GPS)	tbd	float	4	00B0h
VTGTimeTagSeconds	Seconds since midnight Jan 1, 1970	DWORD	4	00B4h
VTGTimeTagMillieconds	Millisecond portion of timetag	DWORD	4	00B8h
Towfish / AUV Depth	to be determined	float	4	00BCh
Reserved Bytes	NULL	WORD	40	00C0h
		Byte Count: Section Total	112	
Channel Parameters				
Module Serial Number	yynnnn K2K-yy-nnnn	LONG	4	00E8h
Channel Usage Code	0 = undefined 1 = bathymetry 2 = sidescan port 3 = sidescan starboard	WORD	2	00ECh
Nominal Frequency	3500 to 210000 Hz	float	4	00EEh
Bandwidth [Hz]		float	4	00F2h
Start Frequency [Hz]		float	4	00F6h
Stop Frequency [Hz]		float	4	00FAh
Waveform Type Code	0 = CW 1 = Chirp	WORD	2	00FEh
Envelope Detection Code	0 = square law detection 1= amplitude detection	WORD	2	0100h
Echogram Data Type Code	6 = Envelope-detected Data (more code options tbd)	WORD	2	0102h
Sample Rate [Hz]		float	4	0104h

FIELD DESCRIPTION	DATA FORMAT / RANGE	Data Type	BYTE COUNT	BYTE OFFSET
Sample Data Type Code	0 = 8-bit unsigned 1 = 16-bit unsigned 2 = 16-bit signed 3 = 32-bit signed 4 = 32-bit float	WORD	2	0108h
Number of Data Samples	(currently fixed at 1600)	DWORD	4	010Ah
Data Truncated Flag	0 = no truncation 1 = data truncated	WORD	2	010Eh
Windowing Filter: Decimation	0 = Rectangular 1 = Hamming 2 = Cosine	WORD	2	0110h
Windowing Filter: Signal	0 = Rectangular 1 = Hamming 2 = Cosine	WORD	2	0112h
Windowing Filter: Analytic	0 = Rectangular 1 = Hamming 2 = Cosine	WORD	2	0114h
Windowing Filter: Transmit	0 = Rectangular 1 = Hamming 2 = Cosine	WORD	2	0116h
Transmit power level code	1 to 4	WORD	2	0118h
Pulse length [ms]	0.0625ms to 4ms (1600 series) 0.0625ms to 24ms (3200 series)	float	4	011Ah
Transmit Scale	not currently in use	float	4	011Eh
Transmit Modulation	not currently in use	WORD	2	0122h
Gain Mode	0 = manual 1 = Auto (AGC)	WORD	2	0124h
Gain Value [dB]	0 to 96	float	4	0126h
Processing Shift	0 to 13	WORD	2	012Ah
TVG Mode Code	0 = None 1 = 5logR 2 = 10logR 3 = 15logR 4 = 20logR 5 = 30logR 6= 40log R 7 = Bottom Ref'd	WORD	2	012Ch
TVG Referenced Depth (used for Bottom Ref'd TVG only)		float	4	012Eh
TxBlank (expressed in working units)	0 to 300.0 m 0 to 984.3 ft 0 to 164.0 fm	float	4	0132h

FIELD DESCRIPTION	DATA FORMAT / RANGE	Data Type	BYTE COUNT	BYTE OFFSET
Draft (expressed in working units)	0 to 100.00 m 0 to 328.08 ft 0 to 54.68 fm	float	4	0136h
Keel Offset	0 to 100.0	float	4	013Ah
Start depth (expressed in working units)	0.0 to 10000.0	float	4	013Eh
End depth (expressed in working units)	10.0 to 12000.0	float	4	0142h
Computed Heave (expressed in working units)		float	4	0146h
Digitized Depth (expressed in working units)	0.00 to 12000.0	float	4	014Ah
Echo Strength (expressed in decibels)	-128 to 0	float	4	014Eh
Depth Validity Flag	0 = good 1 = bad	WORD	2	0152h
Reserved Bytes	NULL	BYTE	40	0154h
		Byte Count: Section Total	148	
Channel Signal Data				
Signal Data	0 to 32767		variable*	017Ch
		Byte Count: Section Total	3200	
Event Mark Condition (follows after all channel sections)				
Event Mark Code	0 to 6	WORD	2	0DFCh
Number of Event Mark Data Bytes	0 to 130	WORD	2	0DFEh
Event Mark Number	0 to 65536	WORD	2	0E00h
Event Mark Annotation String	data dependent	char	variable (max = 145)	0E02h
		Byte Count: Section Total	151	
		Byte Count Structure Total (1 channel)	3731	0E93h
		Byte Count Structure Total (4 channels)	13775	35CFh

* Although the channel data definition allows for variable number of data samples, currently the number is fixed to 1600 words (3200 bytes) which is the value used to determine byte count totals and data offsets.

1.5 Event Mark Code Definitions

Event marks can be initiated from a number of sources; the Event Mark code indicates the source of the event mark as described in Table 1.3. Serial Port and Hypack initiated event marks often have variable-length annotation strings recorded as well.

Table 1.3: Event Mark Codes

Code #	Code Source
0	No Fix
1	Timebase
2	Client Application
3	Hyapck
4	Remote
5	Serial

SEG-Y Structure definitions designed from documentation supplied by Scripps Institution of Oceanography.
Note: Data is recorded in Big-Endian format (most significant byte first) to match original definition.

REEL IDENTIFICATION HEADER (Main Header)

SEG-Y Rev 0 (1979)		SEG-Y Rev1 (2002)		KEL Usage		
Byte #s	**Specification Description**	**Byte #s**	**Specification Description**	**Format**	**Label**	**Usage Description**
0000-3199	3200 Byte EBCDIC Reel header	0000-3199	3200 Byte EBCDIC Reel header	char	text[40][80]	EBCDIC format header using ASCII-to-EDCBIC conversion code credited to T. O'Brien of USGS.
3200-3203	Job identification number	3200-3203	Job identification number	DWORD	Job_id	unused
3204-3207	Line number (one per reel)	3204-3207	Line number (one per reel)	DWORD	line_number	The survey line number assigned with the Record, Start Line dialog in the Echo Control application, and which forms part of the file name. See *Note 1*.
3208-3211	Reel Number	3208-3211	Reel Number	DWORD	reel_number	File number in survey line. *Note 2*
3212-3213	Number of data traces/record	3212-3213	Number of data traces/record	WORD	data_trace_number	set = 1
3214-3215	Number of aux traces/record	3214-3215	Number of aux traces/record	WORD	aux_trace_number	set = 0
3216-3217	Sample interval in microsecs (for this reel of data)	3216-3217	Sample interval in microsecs (for this reel of data)	WORD	reel_sample_time	1000000 / Data Rate *Note 3*
3218-3219	Sample interval in microsecs (for original field recording)	3218-3219	Sample interval in microsecs (for original field recording)	WORD	orig_sample_time	unused
3220-3221	Number of samples per data trace (for this reel of data)	3220-3221	Number of samples per data trace (for this reel of data)	WORD	reel_sample_number	number of data samples
3222-3223	Number of samples per data trace (for original field recording)	3222-3223	Number of samples per data trace (for original field recording)	WORD	orig_sample_number	unused
3224-3225	Data sample format code: 1 floating point (4 bytes) 2 fixed point (4 bytes) 3 fixed point (2 bytes) 4 fixed point with gain code (4 bytes) Auxilary traces use the same number of bytes per sample.	3224-3225	Data sample format code: 1 floating point (4 bytes) 2 fixed point (4 bytes) 3 fixed point (2 bytes) 4 fixed point with gain code (4 bytes) Auxilary traces use the same number of bytes per sample.	WORD	sample_format	Set = 3 fixed point (2 bytes) *Note 4*
3226-3227	CDP fold (Expected number of data traces per CDP ensemble)	3226-3227	CDP fold (Expected number of data traces per CDP ensemble)	WORD	cdp_fold	set = 1

SEG-Y Rev 0 (1979)		SEG-Y Rev1 (2002)		KEL Usage		
Byte #s	**Specification Description**	**Byte #s**	**Specification Description**	**Format**	**Label**	**Usage Description**
3228-3229	Trace sorting code: 1 as recorded (no sort) 2 CDP ensemble 3 single fold continuous profile 4 horizontally stacked	3228-3229	Trace sorting code: 1 as recorded (no sort) 2 CDP ensemble 3 single fold continuous profile 4 horizontally stacked	WORD	trace_sort	set = 1 as recorded
3230-3231	Vertical sum code: 1 no sum 2 two sum N N sum (N=32767)	3230-3231	Vertical sum code: 1 no sum 2 two sum N N sum (N=32767)	WORD	vertical_sum	unused
3232-3233	Sweep frequency at start	3232-3233	Sweep frequency at start	WORD	sweep_freq_start	unused
3234-3235	Sweep frequency at end	3234-3235	Sweep frequency at end	WORD	sweep_freq_end	unused
3236-3237	Sweep length(ms)	3236-3237	Sweep length(ms)	WORD	sweep_time	unused
3238-3239	Sweep type code: 1 linear 2 parabolic 3 exponential 4 other	3238-3239	Sweep type code: 1 linear 2 parabolic 3 exponential 4 other	WORD	sweep_type	unused
3240-3241	Trace number of sweep channel	3240-3241	Trace number of sweep channel	WORD	sweep_trace_number	unused
3242-3243	Sweep trace taper length in ms at start (the taper starts at zero time and is effective for this length)	3242-3243	Sweep trace taper length in ms at start (the taper starts at zero time and is effective for this length)	WORD	sweep_taper_time_start	unused
3244-3245	Sweep trace tape length in ms at end (the ending taper starts at sweep length minus the taper length at end)	3244-3245	Sweep trace tape length in ms at end (the ending taper starts at sweep length minus the taper length at end)	WORD	sweep_taper_time_end	unused
3246-3247	Taper type: 1 linear 2 cos*cos 3 other	3246-3247	Taper type: 1 linear 2 cos*cos 3 other	WORD	taper_type	unused
3248-3249	Correlated data traces: 1 no 2 yes	3248-3249	Correlated data traces: 1 no 2 yes	WORD	correlate_trace	unused

SEG-Y Rev 0 (1979)		SEG-Y Rev1 (2002)		KEL Usage		
Byte #s	**Specification Description**	**Byte #s**	**Specification Description**	**Format**	**Label**	**Usage Description**
3250-3251	Binary gain recovered: 1 no 2 yes	3250-3251	Binary gain recovered: 1 no 2 yes	WORD	binary_gain_recover	unused
3252-3253	Amplitude recovery method: 1 none 2 spherical divergence 3 AGC 4 other	3252-3253	Amplitude recovery method: 1 none 2 spherical divergence 3 AGC 4 other	WORD	amplitude_recover	unused
3254-3255	Measurement system: 1 meters 2 feet	3254-3255	Measurement system: 1 meters 2 feet	WORD	measure_units	Note: echosounder will support fathoms 1 = meters 2 = feet 3 = fathoms
3256-3257	Impulse signal polarity 1= increase in pressure gives negative number of tape 2 =ncrease in pressure gives positive number on tape	3256-3257	Impulse signal polarity 1= increase in pressure gives negative number of tape 2 =ncrease in pressure gives positive number on tape	WORD	impulse_polarity	unused
3258-3259	Vibratory polarity code seismic signal lags pilot signal by 1 337.5 to 22.5 2 22.5 to 67.5 3 67.5 to 112.5 4 112.5 to 157.5 5 157.5 to 202.5 6 202.5 to 247.5 7 247.5 to 292.5 8 292.5 to 337.5	3258-3259	Vibratory polarity code seismic signal lags pilot signal by 1 337.5 to 22.5 2 22.5 to 67.5 3 67.5 to 112.5 4 112.5 to 157.5 5 157.5 to 202.5 6 202.5 to 247.5 7 247.5 to 292.5 8 292.5 to 337.5	WORD	vibrate_polarity	Unused
3262-3599	Optional Data	3260-3499	Optional Data	BYTE	unassigned[240]	unused
		3500-3501	0000 = “traditional” 1975 specification 0100 = Rev 1.0		seg_rev_number	
		3502-3503	fixed length trace flag 1 = all traces have the same sample interval and number of samples as specific in 3216-3217 and 3220-3221 0 = the length of the traces may vary = “traditional” 1975 specification		fixed_length_flag	

SEG-Y Rev 0 (1979)		SEG-Y Rev1 (2002)		KEL Usage		
Byte #s	**Specification Description**	**Byte #s**	**Specification Description**	**Format**	**Label**	**Usage Description**
		3504-3505	number of 3200 extended textual header records that follow the binary header 0 = none = “traditional” 1975 standard -1 = variable number +n = exact number of record		num_extended_headers	
		3506-3599	Unassigned		unassigned[94]	

TRACE HEADER

SEG-Y Rev 0 (1979)		SEG-Y Rev1 (2002)		KEL Usage		
Byte #s	**Specification Description**	**Byte #s**	**Specification Description**	**Format**	**Label**	**Usage Description**
000 - 003	Trace sequence number within line-numbers continue to increase if additional reels are required on same line	000 - 003	Trace sequence number within line-numbers continue to increase if additional reels are required on same line	DWORD	line_trace_number	as defined
004 - 007	Trace sequence number within reel each reel starts with trace number 1	004 - 007	Trace sequence number within reel each reel starts with trace number 1	DWORD	reel_trace_number	as defined
008 - 011	Original field record number	008 - 011	Original field record number	DWORD	orig_record_number	Echosounder record number: 0 to 65535
012 - 015	Trace number within original field record	012 - 015	Trace number within original field record	DWORD	orig_trace_number	1 = LF channel 2 = HF channel
016 - 019	Energy source point number - used when more than one record occurs at the same effective surface location	016 - 019	Energy source point number - used when more than one record occurs at the same effective surface location	DWORD	energy_source_number	unused
020 - 023	CDP ensemble number	020 - 023	CDP ensemble number	DWORD	cdp_number	unused
024 - 027	Trace number within CDP ensemble each ensemble starts with trace number one	024 - 027	Trace number within CDP ensemble each ensemble starts with trace number one	DWORD	cdp_trace_number	unused
028 - 029	Trace Identification code 1 seismic data 2 dead 3 dummy 4 time break 5 uphole 6 sweep 7 timing 8 water break 9-N optional	028 - 029	Trace Identification code 1 seismic data 2 dead 3 dummy 4 time break 5 uphole 6 sweep 7 timing 8 water break 9-N optional	WORD	trace_ident	set = 1 seismic data

SEG-Y Rev 0 (1979)		SEG-Y Rev1 (2002)		KEL Usage		
Byte #s	**Specification Description**	**Byte #s**	**Specification Description**	**Format**	**Label**	**Usage Description**
030 - 031	Number of vertically summed traces yeilding this trace (1 = one trace, 2 = two, etc)	030 - 031	Number of vertically summed traces yeilding this trace (1 = one trace, 2 = two, etc)	WORD	vertical_sum	set = 1
032 - 033	Number of horizontally stacked traces yeilding this trace (1 = one trace, 2 = two, etc)	032 - 033	Number of horizontally stacked traces yeilding this trace (1 = one trace, 2 = two, etc)	WORD	horizontal_sum	set = 1
034 - 035	Data use: 1=production 2=test	034 - 035	Data use: 1=production 2=test	WORD	data_use	unused
036 - 039	Distance from source point to receiver group (negative if opposite to direction in which line is shot)	036 - 039	Distance from source point to receiver group (negative if opposite to direction in which line is shot)	DWORD	source_receiver_dist	unused
040 - 043	Receiver group elevation; all elevations are above sea-level are positive and below are negative	040 - 043	Receiver group elevation; all elevations are above sea-level are positive and below are negative	DWORD	receiver_elevation	unused
044 - 047	Surface elevation at source	044 - 047	Surface elevation at source	DWORD	surface_elevation	unused
048 - 051	Source depth below surface (positive number)	048 - 051	Source depth below surface (positive number)	DWORD	source_depth	set = echosounder draft parameter
052 - 055	Datum elevation at receiver group	052 - 055	Datum elevation at receiver group	DWORD	datum_receiver_elevation	unused
056 - 059	Datum elevation at source	056 - 059	Datum elevation at source	DWORD	datum_source_elevation	unused
060 - 063	Water depth at source	060 - 063	Water depth at source	DWORD	water_depth_source	digitized depth, as determined by the echosounder
064 - 067	Water depth at group	064 - 067	Water depth at group	DWORD	water_depth_group	unused
068 - 069	Scaler to be applied to all elevations and depths in items 40-67 (hex) to give real values. Scaler = 1,+/- 10, +/- 100,+/- 1000, +/- 10000. If positive scaler used as multiplier, if negative scaler used as divisor.	068 - 069	Scaler to be applied to all elevations and depths in items 40-67 (hex) to give real values. Scaler = 1,+/- 10, +/- 100,+/- 1000, +/- 10000. If positive scaler used as multiplier, if negative scaler used as divisor.	WORD	scaler_1	set = -100
070 - 071	Scaler to be applied to all coordinates in 72 - 87 (hex) to give the real values. (same as above)	070 - 071	Scaler to be applied to all coordinates in 72 - 87 (hex) to give the real values. (same as above)	WORD	scaler_2	set = -1000

SEG-Y Rev 0 (1979)		SEG-Y Rev1 (2002)		KEL Usage		
Byte #s	**Specification Description**	**Byte #s**	**Specification Description**	**Format**	**Label**	**Usage Description**
072 - 075	Source coordinate - X	072 - 075	Source coordinate - X	DWORD	source_coord_x	longitude[expressed in degrees] * 60 * 60 *Note 5*
076 - 079	Source coordinate - Y	076 - 079	Source coordinate - Y	DWORD	source_coord_y	latitude[expressed in degrees] * 60 * 60
080 - 083	Group coordinate - X	080 - 083	Group coordinate - X	DWORD	group_coord_x	unused
084 - 087	Group coordinate - Y	084 - 087	Group coordinate - Y	DWORD	group_coord_y	unused
088 - 089	Coordinate units: 1 = length (meters or feet) 2 = seconds of arc	088 - 089	Coordinate units: 1 = length (meters or feet) 2 = seconds of arc	WORD	coord_units	set = 2 (seconds of arc)
090 - 091	Weathering velocity	090 - 091	Weathering velocity	WORD	weathering_velocity	unused
092 - 093	Subweathering velocity	092 - 093	Subweathering velocity	WORD	subweathering_velocity	unused
094 - 095	Uphole time at source	094 - 095	Uphole time at source	WORD	source_uphole_time	unused
096 - 097	Uphole time at group	096 - 097	Uphole time at group	WORD	group_uphole_time	unused
098 - 099	Source static corrections	098 - 099	Source static corrections	WORD	source_static_correct	unused
100 - 101	Group static correction	100 - 101	Group static correction	WORD	group_static_correct	unused
102 - 103	Total static applied. (0 if none applied)	102 - 103	Total static applied. (0 if none applied)	WORD	total_static	unused
104 - 105	Lag time A	104 - 105	Lag time A	WORD	lag_time_a	unused
106 - 107	Lag time B	106 - 107	Lag time B	WORD	lag_time_b	unused
108 - 109	Delay recording time(ms)	108 - 109	Delay recording time(ms)	WORD	record_delay_time	1000 * 2 * start depth / sound speed *Note 6*
110 - 111	Mute time start	110 - 111	Mute time start	WORD	mute_time_start	unused
112 - 113	Mute time end	112 - 113	Mute time end	WORD	mute_time_end	unused
114 - 115	Number of samples in this trace	114 - 115	Number of samples in this trace	WORD	trace_sample_number	as defined
116 - 117	Sample interval(us) for this trace	116 - 117	Sample interval(us) for this trace	WORD	sample_time	1000000 / data rate
118 - 119	Gain type of field instruments: 1 fixed 2 binary 3 floating point N optional use	118 - 119	Gain type of field instruments: 1 fixed 2 binary 3 floating point N optional use	WORD	instrument_gain_type	unused

SEG-Y Rev 0 (1979)		SEG-Y Rev1 (2002)		KEL Usage		
Byte #s	**Specification Description**	**Byte #s**	**Specification Description**	**Format**	**Label**	**Usage Description**
120 - 121	Instrument gain constant	120 - 121	Instrument gain constant	WORD	instrument_gain_constant	unused
122 - 123	Instrument early or initial gain	122 - 123	Instrument early or initial gain	WORD	instrument_init_gain	unused
124 - 125	Correlated 1=no 2=yes	124 - 125	Correlated 1=no 2=yes	WORD	correlated_trace	unused
126 - 127	Sweep frequency at start	126 - 127	Sweep frequency at start	WORD	sweep_freq_start	unused
128 - 129	Sweep frequency at end	128 - 129	Sweep frequency at end	WORD	sweep_freq_end	unused
130 - 131	Sweep length (ms)	130 - 131	Sweep length (ms)	WORD	sweep_time	pulse length
132 - 133	Sweep type 1 linear 2 parabolic 3 exponential 4 other	132 - 133	Sweep type 1 linear 2 parabolic 3 exponential 4 other	WORD	sweep_type	unused
134 - 135	Sweep trace taper length at start (ms)	134 - 135	Sweep trace taper length at start (ms)	WORD	sweep_taper_time_start	unused
136 - 137	Sweep trace taper length at end (ms)	136 - 137	Sweep trace taper length at end (ms)	WORD	sweep_taper_time_end	unused
138 - 139	Taper type: 1 linear 2 cos*cos 3 other	138 - 139	Taper type: 1 linear 2 cos*cos 3 other	WORD	taper_type	unused
140 - 141	Alias filter frequency, if used	140 - 141	Alias filter frequency, if used	WORD	alias_filt_freq	unused
142 - 143	Alias filter slope	142 - 143	Alias filter slope	WORD	alias_filt_slope	unused
144 - 145	Notch filter frequency, if used	144 - 145	Notch filter frequency, if used	WORD	notch_filt_freq	unused
146 - 147	Notch filter slope	146 - 147	Notch filter slope	WORD	notch_filt_slope	unused
148 - 149	Low cut frequency, if used	148 - 149	Low cut frequency, if used	WORD	low_cut_freq	unused
150 - 151	High cut frequency, if used	150 - 151	High cut frequency, if used	WORD	high_cut_freq	unused
152 - 153	Low cut slope	152 - 153	Low cut slope	WORD	low_cut_slope	unused
154 - 155	High cut slope	154 - 155	High cut slope	WORD	high_cut_slope	unused
156 - 157	Year data recorded	156 - 157	Year data recorded	WORD	year	PC Date: Year

SEG-Y Rev 0 (1979)		SEG-Y Rev1 (2002)		KEL Usage		
Byte #s	**Specification Description**	**Byte #s**	**Specification Description**	**Format**	**Label**	**Usage Description**
158 - 159	Day of year	158 - 159	Day of year	WORD	day	PC Date: Day of year + 1
160 - 161	Hour of day (24 hour clock)	160 - 161	Hour of day (24 hour clock)	WORD	hour	PC Time of trace recording: hour
162 - 163	Minute of hour	162 - 163	Minute of hour	WORD	minute	PC Time of trace recording: minute
164 - 165	Second of minute	164 - 165	Second of minute	WORD	second	PC Time of trace recording: second
166 - 167	Time basis code 1 = local 2 = GMT 3 = other	166 - 167	Time basis code 1 = local 2 = GMT 3 = other	WORD	time_basis_code	unused
168 - 169	Trace weighting factor defined as 2-n volts for the lsb. (n=0,1...32767)	168 - 169	Trace weighting factor defined as 2-n volts for the lsb. (n=0,1...32767)	WORD	trace_weight	unused
170 - 171	Geophone group number of roll switch position one	170 - 171	Geophone group number of roll switch position one	WORD	group_switch_number	unused
172 - 173	Geophone group number of trace 1 within original field	172 - 173	Geophone group number of trace 1 within original field	WORD	group_trace_number	unused
174 - 175	Geophone group number of last trace within original field	174 - 175	Geophone group number of last trace within original field	WORD	group_last_trace_number	unused
176 - 177	Gap size (total number of groups dropped)	176 - 177	Gap size (total number of groups dropped)	WORD	gap_size	unused
178 - 179	Overtravel associated with taper at beginning or end of line 1 down (or behind) 2 up (or ahead)	178 - 179	Overtravel associated with taper at beginning or end of line 1 down (or behind) 2 up (or ahead)	WORD	taper_overtravel	unused
180 - 239	Unassigned *Note 7*	180 - 183	X coordinate of CDP position	WORD WORD	Kel_SpmCode Kel_PingStartTimeHr	Frequency channel code Time @ start of ping: Hours
		184 - 187	Y coordimate of CDP position	WORD WORD	Kel_PingStartTimeMin Kel_PingStartTimeSec	Time @ start of ping: Minutes Time @ start of ping: Seconds
		188 - 191	for 3-D poststack data, in-line number	WORD WORD	Kel_PingStartTimeMs Kel_TxPower	Time @ start of ping: Milliseconds Transmit power parameter setting (1 to 8)
		192 - 195	for 3-D poststack data, cross-line number	WORD WORD	Kel_RxGain Kel_ProcessingGain	Receive gain parameter setting (0 to 255) Processing gain parameter setting (0 to 8)

SEG-Y Rev 0 (1979)		SEG-Y Rev1 (2002)		KEL Usage		
Byte #s	**Specification Description**	**Byte #s**	**Specification Description**	**Format**	**Label**	**Usage Description**
		196 - 199	Shotpoint number	WORD WORD	Kel_Sensitivity Kel_MuxChannel	Sensitivity parameter setting (1 to 100) Multiplexer channel code (not currently used)
		200 - 201	Scaker to be aplied to the shotpoint number	WORD	Kel_EchoStrength	Echo Strength expressed in dB
		202 - 203	Trace value measurement unit: -1 = other 0 = unknown 1 = Pascal [Pa] 2 = Volts [V] 3 = Millivolts [V] 4 = Amperes [A] 5 = Meters [m] 6 = meters per second [m/s] 7 = meters per second squared [m/s^2] 8 = Newton [N] 9 = Watt [W]	WORD	Kel_PrimaryChannel	Primary channel parameter setting
		204 - 207	Transduction Constant	WORD WORD	Kel_PulseLength Kel_TxBlank	Pulse Length parameter selection code Transmit blanking paramter expressed in 1/10 system units
		208 - 209	Transduction Exponent	WORD	Kel_SoundSpeed	Sound Speed Parameter Setting
		210 - 211	Transduction Units -1 = other 0 = unknown 1 = Pascal [Pa] 2 = Volts [V] 3 = Millivolts [V] 4 = Amperes [A] 5 = Meters [m] 6 = meters per second [m/s] 7 = meters per second squared [m/s^2] 8 = Newton [N] 9 = Watt [W]	WORD	Kel_StartDepth	Active window start depth
		212 - 213	Device/Trace ID	WORD	Kel_EndDepth	Active window end depth
		214 - 215	Scalar to be applied to times specified in 94-113 to give true time value	WORD	Kel_Undefined	No longer defined
		216 - 217	Source Type / Orientation	WORD	Kel_Heave	Heave expressed in 1/100 of system units

SEG-Y Rev 0 (1979)		SEG-Y Rev1 (2002)		KEL Usage		
Byte #s	**Specification Description**	**Byte #s**	**Specification Description**	**Format**	**Label**	**Usage Description**
		218 - 223	Source Energy Direction with respect to the source orientation	WORD WORD WORD	Kel_HeaveSensorLatency Kel_GPSLatency Kel_EventMarkCode	Latency since heave data received [sec] Latency since GPS data received [sec] Event mark code: 0 = no event mark
		224 - 227	Source Measurement Mantissa	WORD WORD	Kel_EventMarkNumber Kel_Scalar	Event mark number if event present Scalar applied to digitized depth and sampling data rate
		228 - 229	Source Measurement Exponent	DWORD	Kel_DataRate	Sampling data rate
		230 - 231	Source Measurement Unit -1 = other 0 = unknown 1 = Joule [J] 2 = Kilowatt [kW] 3 = Pascal [Pa] 4 = Bar [Bar] 5 = Bar-Meter [Bar-m] 6 = Newton [N] 7 = Kilograms [kg]			
		232 - 239	Optional Data		unassigned	unassigned

Note 1: The Echo Control application names SEG-Y files as follows:

Hxxx_hhmm.sgy

where the initial letter (H or L) identifies the echosounder high or low frequency channel, the following 3 digits identifies the survey line assigned with the Record, Start Line dialog, and the last four digits define the time the file was created. A future release will support a more flexible file naming scheme, but it should not be expected any time soon.

Note 2: A new file is created whenever any of the Main Header parameter values (such as sample interval or number of samples per trace) become invalid. This typically occurs when echosounder range, phase or pulse length is changed, or whenever bottom track is lost while in autophase mode.

Note 3: Sample interval in microseconds. The specified units for this parameter do not provide adequate resolution. The KEL_DataRate parameter in the Unassigned Bytes section of the Trace Header should be used instead.

Note 4: Data is recorded in Big-Endian form (most significant byte first). Note that the actual content of the recorded data is determined by the echosounder's embedded software. Compilation options (individually defined for high and low frequency channels) are used to specify one of three different formats for the SEG-Y data: 1) raw (as digitized), 2) filtered (bandpass or chirp, as the case may be), or 3) detected envelope data. Note that the first two formats are signed, while the third is unsigned. The default format is option 3, detected envelope.

Note 5: Position data is only recorded if a GPS receiver producing GGA or GGL strings is connected and configured on one of the echosounder's serial ports.

Note 6: SEG-Y data is recorded only for the portion of the water column which is displayed in the echosounder's window on the PC, which is controlled by the echosounder's RANGE and PHASE settings. The shallow end of this window is referred to as the "start depth".

Note 7: These "unassigned bytes" are used by KEL for additional information which is not specifically provided in the standard specification. IMPORTANT: These additional fields are NOT compatible with the Rev 1 specification. Do not use extended fields if file reader expects Rev1 formatting.

Structure Recording Sequence

XTF is a file format defined by Triton Elics International and used by their Isis application as well as various other seismic packages. The implementation details contained in this document define the field usage employed by Knudsen Engineering to ensure compatibility with Caris's HIPS/SIPS products. Adjustment will probably need to be made as different "flavour" requirements are identified.

At file creation the main header structure is written:

XTFFileHeader

Then for every ping that occurs the following structures are formatted and written to the file in the following order:

XTFPingHeader
Port Channel Header
Port Channel Data (1600 words)
Starboard Channel Header
Starboard Channel Data (1600 words)
XTFNotesHeader (only if a supported fix mark condition exists)

Structure Usage

CHANINFO structure:

One-time information describing each channel. This is data pertaining to each channel that will not change during the course of a run. Recorded in the XTFFILEHEADER for each channel

Field Name	Format	KEL Data Usage	# Bytes
TypeOfChannel	BYTE	1 = PORT (HF channel) 2 = STARBOARD (LF channel	1
SubChannelNumber;	BYTE	0	1
CorrectionFlags	WORD	1 = RAW	2
UniPolar	WORD	1 = UNIPOLAR	2
BytesPerSample	WORD	2	2
Reserved	DWORD	Expected # of samples per channel (1600)	4
ChannelName[16]	char	ie. "Port 200"	16
VoltScale	float	3.0	4
Frequency	float	nominal frequency [kHz] ie. 200	4
HorizBeamAngle	float	0	4
TiltAngle	float	0	4
BeamWidth	float	0	4
OffsetX	float	0	4
OffsetY	float	0	4
OffsetZ	float	0	4
OffsetYaw	float	0	4
OffsetPitch	float	0	4
OffsetRoll	float	0	4
Beams per Array	WORD	0	2
ReservedArea2[54]	char	0	54
Byte Count Total			128

XTFFILEHEADER structure:

Field Name	Format	KEL Data Usage	# bytes
FileFormat	BYTE	123	1
SystemType	BYTE	0	1
RecordingProgramName[8]	char	“EchoCtrl” or “PostSrvy”	8
RecordingProgramVersion[8]	char	“Vxx.xx”	8
SonarName[16]	char	“”	16
SonarType	WORD	0	2
NoteString[64]	char	“”	64
ThisFileName[64]	char	filename	64
NavUnits	WORD	0 = METERS (from Hypack) 3 = DEGREES (from GGA or GLL)	2
NumberOfSonarChannels	WORD	2 (inactive channel filled with NULLs)	2
NumberOfBathymetryChannels	WORD	0	2
NumberOfForwardLookArrays	WORD	0	2
NumberOfEchoStrengthChannels	WORD	0	2
Reserved1	WORD	0	2
Reserved2	WORD	0	2
Reserved3	WORD	0	2
Reserved4	WORD	0	2
ProjectionType[12]	BYTE	0	12
SpheriodType[10]	BYTE	0	10
NavigationLatency	long	0	4
OriginY	float	0	4
OriginX	float	0	4
NavOffsetY	float	0	4
NavOffsetX	float	0	4
NavOffsetZ	float	0	4
NavOffsetYaw	float	0	4
MRUOffsetY	float	0	4
MRUOffsetX	float	0	4
MRUOffsetZ	float	0	4
MRUOffsetYaw	float	0	4
MRUOffsetPitch	float	0	4
MRUOffsetRoll	float	0	4
ChanInfo[6]	CHANINFO	See channel info description	768
Byte Count Total			1024

XTFPINGHEADER structure:

Packets must be padded to a multiple of 64 bytes. Triton equation is: size = ((size+63)/64)*64
The data here can change from ping to ping but will pertain to all channels that are at the same time as this ping.

Field Name	Format	KEL Data Usage	# bytes
MagicNumber	WORD	0xFACE (hex)	2
HeaderType	BYTE	XTF_HEADER_SONAR = 0	1
SubChannelNumber	BYTE	0	1
NumChansToFollow	WORD	2 (inactive channel filled with NULLs)	2
Reserved1[2]	WORD	0	4
NumBytesThisRecord	DWORD	1 channel = 256 + 64 + 3200 = 3520 2 channels = 256 + 2*(64+3200) = 6784 where: sizeof(XTFPINGHEADER) = 256 sizeof(XTFPINGCHANHEADER) = 64 (2*PING_SIZE) = 3200	4
Date and time of the ping			
Year	WORD	Computer date when this record was saved	2
Month	BYTE	Computer date when this record was saved	1
Day	BYTE	Computer date when this record was saved	1
Hour	BYTE	Sounder time when ping started - hours	1
Minute	BYTE	Sounder time when ping started - minutes	1
Second	BYTE	Sounder time when ping started - seconds	1
HSeconds	BYTE	Sounder time when ping started - hundredths of seconds (0-99)	1
JulianDay	WORD	Number of days since January 1	2
General information			
CurrentLineID	WORD	Line # if one exists	2
EventNumber	WORD	Event number if exists	2
PingNumber	DWORD	Sounder Record Number	4
SoundVelocity	float	speed of sound / 2 [m/s]	4
OceanTide	float	0	4
Reserved2	DWORD	0	4
CTD information			
ConductivityFreq	float	0	4
TemperatureFreq	float	0	4
PressureFreq	float	0	4
PressureTemp	float	0	4
Computed CTD information			
Conductivity	float	0	4
WaterTemperature	float	0	4
Pressure	float	0	4
ComputedSoundVelocity	float	0	4

Field Name	Format	KEL Data Usage	# bytes
Sensors information			
MagX	float	0	4
MagY	float	0	4
MagZ	float	0	4
AuxVal1	float	0	4
AuxVal2	float	0	4
AuxVal3	float	0	4
AuxVal4	float	0	4
AuxVal5	float	0	4
AuxVal6	float	0	4
SpeedLog	float	0	4
Turbidity	float	0	4
Ship Navigation information.			
ShipSpeed	float	Boat speed [knots], 0 if unavailable	4
ShipGyro	float	0	4
ShipYcoordinate	double	Ship latitude or northing	8
ShipXcoordinate	double	Ship longitude or easting	8
ShipAltitude	WORD	0	2
ShipDepth	WORD	Sidescan depth used for slant range correction	2
Sensor Navigation information			
FixTimeHour	BYTE	0	1
FixTimeMinute	BYTE	0	1
FixTimeSecond	BYTE	0	1
Reserved4	BYTE	0	1
SensorSpeed	float	0	4
KP	float	0	4
SensorYcoordinate	double	0	8
SensorXcoordinate	double	0	8
Tow Cable information			
SonarStatus	WORD	0	2
RangeToFish	WORD	0	2
BearingToFish	WORD	0	2
CableOut	WORD	0	2
Layback	float	0	4
CableTension	float	0	4
Sensor Attitude information			
SensorDepth	float	0	4
SensorPrimaryAltitude	float	0	4
SensorAuxAltitude	float	0	4
SensorPitch	float	0	4

Field Name	Format	KEL Data Usage	# bytes
SensorRoll	float	0	4
SensorHeading	float	0	4
additional attitude data			
Heave	float	0	4
Yaw	float	0	4
AttitudeTimeTag	DWORD	Computer time tag (milliseconds since midnight of Jan 1, 1970)	4
Miscellaneous			
DOT	float	0	4
NavFixMilliseconds	DWORD	Computer time tag (milliseconds since midnight of Jan 1, 1970)	4
ComputerClockHour	unsigned char	Computer time when this record was saved - hours	1
ComputerClockMinute	unsigned char	Computer time when this record was saved - minutes	1
ComputerClockSecond	unsigned char	Computer time when this record was saved - seconds	1
ComputerClockHsec	unsigned char	Computer time when this record was saved - hundredths of seconds	1
FishPositionDeltaX	short	0	2
FishPositionDeltaY	short	0	2
FishPositionErrorCode	unsigned char	0	1
ReservedSpace2[11]	BYTE	0	11
Byte Count Total			256

XTFPINGCHANHEADER structure:

This is data that can be unique to each channel from ping to ping. It is stored at the front of each channel of sonar data.

Field Name	Format	KEL Data Usage	# bytes
ChannelNumber	WORD	0=port (low frequency) 1=stbd (low frequency)	2
DownsampleMethod	WORD	2=MAX,	2
SlantRange	float	0	4
GroundRange	float	0	4
TimeDelay	float	0	4
TimeDuration	float	2*start depth / speed of sound	4
SecondsPerPing	float	amount of time, in seconds, from ping to ping	4
ProcessingFlags	WORD	0 = TVG off 4 = TVG on	2
Frequency	WORD	nominal frequency [kHz] ie 200	2
InitialGainCode	WORD	0	2
GainCode	WORD	RxGain parameter (0-255)	2
BandWidth	WORD	0	2
Contact information - updated when contacts are saved through Target.exe			
ContactNumber	DWORD	0	4
ContactClassification	WORD	0	2
ContactSubNumber	unsigned char	0	1
ContactType	unsigned char	0	1
NumSamples	DWORD	Expected # of samples per channel (1600)	4
Reserved	WORD	0	2
ContactTimeOffTrack	float	0	4
ContactCloseNumber	unsigned char	0	1
Reserved2	unsigned char	0	1
FixedVSOP	float	0	4
ReservedSpace[6]	BYTE	0	6
Byte Count Total			64

XTFNOTESHEADER structure:

An annotation record is a line of text which can be saved to the file and is displayed in the "Notes" field on the Isis display. This text is displayed during playback. Additionally, this text may be printed in realtime or in playback. This can be activated in the Print Annotation dialog box.

Field Name	Format	KEL Data Usage	# bytes
MagicNumber	WORD	0xFACE (hex)	2
HeaderType	BYTE	XTF_HEADER_NOTES	1
SubChannelNumber	BYTE	0	1
NumChansToFollow	WORD	0	2
Reserved[2]	WORD	0	4
NumBytesThisRecord	DWORD	256	4
Date and time of the annotation			
Year	WORD	year	2
Month	BYTE	month	1
Day	BYTE	day	1
Hour	BYTE	hour	1
Minute	BYTE	minute	1
Second	BYTE	second	1
ReservedBytes[35]	BYTE	0	35
NotesText[200]	char	Fix annotation	200
Byte Count Total			256

ECHOSOUNDER CONCEPTS

TECHNICAL NOTE

D101-02251
Revision 4.1
July 6, 2009

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CONTENTS

1 BASIC ECHOSOUNDER THEORY. 1-1
1.1 Basic Concepts. 1-1
1.2 Pings and Echoes. 1-1
1.3 Bottom Characteristics. 1-1
1.4 Pulse Length. 1-1
1.5 Sound Speed. 1-2
1.6 Draft. 1-2
1.7 Bar Check. 1-2

2 ACCURACY OF THE KNUDSEN ECHOSOUNDERS. 2-1
2.1 Introduction. 2-1
2.2 Repeatability. 2-1
2.2.1 Background. 2-1
2.2.2 Amplitude Effects. 2-1
2.2.3 Bottom Type. 2-2
2.2.4 Sample Rate Effects and Truncation Noise. 2-2
2.2.5 Pulse Length Effects. 2-2
2.2.6 Frequency Effects. 2-2
2.3 Scale Errors. 2-3
2.4 Offset Errors. 2-3
2.5 Summary. 2-3

3 DIGITIZED DEPTH VERSUS PRINTED ECHOGRAM. 3-1

1 BASIC ECHOSOUNDER THEORY

1.1 Basic Concepts

The following section is intended for new or occasional operators. It provides a brief introduction to echosounding and to a few of the most important concepts. Experienced users may safely skip this section.

1.2 Pings and Echoes

An echosounder is an acoustic echo ranging device. It measures the depth of the water by transmitting brief pulses of ultrasound downward toward the ocean bottom, and measuring the time it takes for the bottom echo to return. The transmitted pulse, traditionally called a "ping", is a tone of a specified frequency with a duration of anywhere from a sixteenth of a millisecond to four milliseconds. The transducer is mounted through the hull of the ship, near the keel, with its active face pointed straight down. The same transducer is used for both transmitting the ping, and receiving the echo signal. The intensity of the received signal as a function of depth is printed vertically on the graphic recorder. After many repeated pings the bottom is visible as a horizontal black line, which follows the contours of the bottom. The sharpness and clarity of the line depend on the strength and quality of the echo, which depends on many factors, including bottom characteristics, pulse length, depth of the water, and the amount of ambient noise (noise "pollution", which comes from many sources and is unavoidable). The location of the strongest echo is "detected" by software and displayed/recorded as a depth in metres. Each frequency has its own independent display/record.

Echosounder operation is affected by many factors - some much more dominant in their effect than others. Several of the more important factors and their effects are discussed below.

1.3 Bottom Characteristics

The strength of the received echo is strongly affected by the type of bottom. The strongest echoes are produced by rock, gravel or sand (such bottoms are said to exhibit high "target strength"). Mud or silt surfaces have low target strength and produce weaker echoes.

The bottom characteristics can often be deduced from a graphic record, as a result of penetration of the ping into the ocean bottom. Echoes from harder layers a few decimeters beneath the surface of the sea floor often show up as a characteristic layering effect on the graphic record. This is particularly evident in the case of silt overlying rock.

1.4 Pulse Length

The echosounder's receiver processes the received signal with a bandpass filter with a passband centred at the transducer frequency. This filter allows the received echo to pass through, but rejects ambient noise at all other frequencies. It would seem logical to use the narrowest possible bandwidth, to achieve the greatest possible noise rejection, and thus detect the weakest echoes of the transmit pulse. Unfortunately, it isn't that easy. A signal pulse has a bandwidth approximately equal to the inverse of its duration - thus a one millisecond pulse needs a receive filter with a bandwidth of at least 1 kHz, or it will be attenuated along with the out-of-band noise. The shortest pulses need the widest bandwidth (and achieve poorest noise rejection) while the longest pulses can use the narrowest filters, with the best noise rejection.

On the other hand, the short pulses produce better "range resolution", which permits more accurate depth measurement, and shows more detail on the bottom. Generally, short pulses are used in shallow water, where resolution is important, and where echoes are strong, while long pulses are used in deep water where echoes are weaker, and the noise rejection capability of narrowband filtering is more important.

1.5 Sound Speed

Because the 1600 series and 3200 series Echosounders are digital systems with a quartz crystal timebase, they do not require internal recalibration due to aging or temperature, and can measure the return time of the echo with a great deal of accuracy. The ultimate accuracy of the depth measurement also depends on the accuracy of the sound speed value used in the computation.

The speed of sound is not a constant, but depends on several factors, most importantly the salinity and the temperature of the water. Normally, the variations in sound speed from location to location are small enough that only occasional adjustments to this parameter are required, such as when transiting from fresh water to salt water. If maximum accuracy is important however, velocity measurements must be made and the sound speed value entered into the echosounder. Since sound speed can vary significantly with depth (as a result of temperature or salinity gradients) it may be necessary to enter an average velocity based on a measured sound velocity profile.

1.6 Draft

Draft is the nautical term used for the depth of the keel (the deepest point) of the vessel below the surface of the water. In echosounders it generally refers to the depth of the transducer below the water surface. The echosounder compensates for the effect of draft, both in the graphic record and in the digital depth display.

The amount of draft varies from time to time as a result of vessel loading, or a transit from fresh water to salt water, and a new value must periodically be entered into the echosounder.

1.7 Bar Check

A "bar check" is a test procedure used to set-up the appropriate speed of sound and draft settings for a sounding session. Typically, a bar check would be performed as follows.

A "bar" (a target which will return a distinct echo)is lowered to a known short distance below the surface. The draft is then adjusted until the depth return from the bar equals the known value. After the draft has been adjusted, the bar is then lowered to a deeper known depth. The sound speed is then adjusted until the depth return from the bar equals the known value. This procedure must be repeated several times until both elements are calibrated. After this procedure, the system will calibrated for the current water conditions and can be left unmodified for the remainder of the sounding session.

2 ACCURACY OF THE KNUDSEN ECHOSOUNDERS

Note: We are frequently asked to specify the "accuracy" of the echosounders, and the answer is never straightforward. Although the following discussion does not provide the definitive response, it may shed light on some of the issues.

2.1 Introduction

Although modern echosounders can be sophisticated and complex, the principle on which they operate is simple - transmit a "ping" and listen for the echo. The time it takes for the bottom echo to return is directly proportional to the round trip distance, or twice the water depth. The accuracy of the depth value depends on a great many factors, some intrinsic to the echosounder and some, the local speed of sound for example, which are environmental factors beyond the control of the echosounder designer. This report discusses those factors which are affected by the design and operation of the echosounder.

Sources of error can conveniently be divided into three categories; repeatability, scale and offset. Repeatability is a fundamental limitation - there is no point in calibrating scale and offset to centimetres if the ping-to-ping variability is measured in decimetres. A brief discussion of some of the factors affecting repeatability and some of the design measures taken to enhance this characteristic is provided below.

Deterministic scale and offset errors which are amenable to calibration represent the main focus of this report. Echosounders are traditionally provided with offset and scale adjustments (in the form of draft and sound speed controls) which permit the user to calibrate the unit for his specific transducer installation and local water conditions. The user can set these two parameters by performing a bar check at two different depths (draft is set at the shallow depth, and sound speed at the deeper depth) and iterating the procedure as necessary to refine the values. Alternatively, the user can measure the draft and sound speed directly and enter the values into the echosounder. In this latter case, the user is trusting that the echosounder manufacturer has calibrated the unit correctly (particularly the draft) at the factory. This report discusses the technical aspects of echosounder calibration and accuracy.

2.2 Repeatability

2.2.1 Background

As already mentioned, ping-to-ping repeatability of the measured depth value is a fundamental limitation to echosounder accuracy. It is important to realize that the typical variability in the echo time-of-arrival measurement is much smaller than the total duration of the echo. The problem is not so much to locate the echo but to locate the precise point in the echo, time after time, which represents the calibrated depth value. Repeatability of the depth measurement therefore hinges on repeatability of the echo itself, at the transducer, and also on the repeatability of the process by which the depth determination is made within the echosounder.

2.2.2 Amplitude Effects

The depth determination invariably involves measurement of the precise instant at which the echo amplitude exceeds some threshold. For this to produce repeatable results, the echo amplitude has to be repeatable in relation to the threshold. Obviously echo amplitude varies widely depending on transmitted power, water depth, bottom reflectivity and receiver gain, and so amplitude normalization is a basic requirement of precision echosounding. Traditionally, amplitude normalization has been accomplished with a combination of automatic gain control (when available) and a considerable reliance on operator attention to control settings.

Amplitude normalization in the KEL Echosounders starts with an assessment of the amplitude of each received echo. This is performed in software, after the signal has been digitized, filtered and envelope detected. The details of the algorithm are

beyond the scope of this report, but basically it involves increasing the sample frequency of the envelope record by a factor of four with a cubic spline interpolation, and then cross-correlating the upsampled signal with a replica of the leading edge of the expected echo (this is also part of the bottom-picking algorithm). The correlation peak is scaled to produce a very accurate estimate of echo amplitude. Another filter is used with the correlation results to obtain the background noise level. A threshold is then computed as a specified fraction of the echo amplitude (usually 50%). The point in the sample record at which the envelope signal crosses the threshold is computed using polynomial interpolation and floating point arithmetic. The end result of this process is to decouple the depth measurement from both amplitude variations and sample rate limitations.

2.2.3 Bottom Type

Different bottom types can affect not only the amplitude of the return echo but also its shape. A very smooth, flat bottom provides an almost specular reflection with a well defined leading edge and very little off-axis return. A rough bottom, on the other hand, returns a considerable amount of off-axis scattering which tends to elongate the pulse and shift the point of peak amplitude downward. Generally speaking, bottom type effects are more difficult to compensate in the design of the echosounder than the simple amplitude effects mentioned above. The template-matching correlation scheme used in the Echosounders for both bottom picking and amplitude normalization is very effective in minimizing sensitivity to bottom type.

2.2.4 Sample Rate Effects and Truncation Noise

This repeatability issue is peculiar to digital echosounders. It refers to the errors which accumulate whenever a timebase parameter is truncated or rounded off to the nearest sample interval or improperly interpolated. It ultimately places limits on the achievable resolution and therefore the repeatability of the time delay measurement. In early designs it tended to show up in the form of A/D converter sample-rate limitations. In modern echosounder designs it is more likely to be the result of fixed-point arithmetic or poorly written software.

The only practical solution to truncation and round-off noise is to use floating point arithmetic for all timebase related computations, and to use continuous polynomial interpolation when working with time-sampled data. This is the approach taken in all current releases of KEL software. Digital timebase errors are essentially nonexistent in KEL Echosounders.

2.2.5 Pulse Length Effects

If properly implemented, different transmit pulse lengths are matched to different receive filters, with short pulses matched to wide bandwidth filters, and vice versa (there is very little point in transmitting a long pulse unless the receive filter has an appropriately narrow noise bandwidth). The “group delay” of an analog or digital filter is inversely related to the bandwidth and can be quite considerable in a narrowband filter. Fortunately this is a deterministic effect and can be corrected (see the section on offset calibration). A more fundamental repeatability issue arises from the simple observation that long, narrowband pulses have a much longer rise time than short, wideband pulses, and the threshold crossing instant is more sensitive to minor amplitude variations. This is just another way of stating the well-known fact that longer pulses provide poorer range resolution than short pulses.

2.2.6 Frequency Effects

Hydrographic surveyors are well acquainted with the fact that low frequency sound penetrates soft sediments more readily than high frequency signals. They are also aware that the bottoms of oceans, lakes and rivers are often characterized by one or more layers of soft sediments (sometimes very soft, as in “fluff”, which may be more liquid than solid) overlying harder, more acoustically opaque materials. Echoes are generated at the interface between substances of low acoustic impedance (such as water) and higher acoustic impedance (sediment). An even greater acoustic impedance difference may exist between buried layers of soft and hard sediment. A low frequency echosounder will often identify a buried layer of hard sediment as

the “real” bottom, while a two-channel echosounder will often detect the shallowest interface on the high frequency channel, and a deeper layer on the low frequency.

If the digitized depth values are consistent under these conditions, the results with a two-channel echosounder can provide useful information about the type of bottom. More often, the depth values “bounce” back and forth between one interface and another, producing misleading data.

2.3 Scale Errors

Modern echosounders use extremely precise quartz crystal timebase control, so in theory calibration error in the scale parameter (sound speed) is effectively zero and can safely be disregarded. In practice, the theoretically achievable accuracy can be compromised by errors in the digital processing of timebase parameters, mostly as a result of fixed-point arithmetic or truncation errors. However, this is a software issue, and is easily resolved with good programming practice and floating-point arithmetic as used in the KEL Echosounders.

Note that the scale parameter calibration error referred to here is the accuracy of the correction applied to the depth value by the echosounder to compensate for the speed of sound value entered by the user, either in the course of a bar check or from a sound velocimeter. The depth accuracy still depends ultimately on the accuracy of the sound velocity value provided by the user. In practice, errors in the sound velocity value account for virtually all of the scale effects on the accuracy of the depth measurement.

2.4 Offset Errors

Errors in the offset (draft) parameter result of all of the small time delays built into the signal paths in the echosounder. Because of the very wide bandwidth of the Sounder 1600 and Chirp 3200 analog front ends, the error resulting from analog group delay is negligible (group delay is inversely proportional to bandwidth). The same can not be said for the group delay through the digital filters, which may be considerable. Fortunately, the group delay of a digital filter is deterministic and can be precisely calculated for any filter at any frequency. The group delay through a transversal bandpass or lowpass digital filter depends on the sampling interval and the number of taps, and inversely with the bandwidth, and is a very straightforward computation. The formula is somewhat different for the correlation filters used with chirp signals, but the precision with which the group delay can be calculated is the same.

This actually represents one of the big advantages of the digital signal filters used in the KEL products, over the multiple analog filters used in other “digital” echosounders. The group delay values of the digital filters are computed precisely in software, and are compensated for in software. No “tuning” of pots or coils in individual echosounders is involved, and of course software never drifts.

It should be noted that all of the digital filtering in KEL Echosounders, for both CW and chirp signals, is performed with transversal, or finite impulse response (FIR) filters which are unconditionally stable.

The two-way group delay of the transducer itself contributes a very small amount to this offset error, varying slightly from transducer to transducer (the lower the Q of the transducer the smaller the group delay).

2.5 Summary

To summarize the discussion above:

1) The **scale** error contributed by the echosounder is essentially zero. Scale accuracy is normally controlled by the accuracy of the speed of sound value which is entered by the operator, either from a sound velocity instrument or in

the course of a bar check.

2) The **offset** error contributed by the echosounder is essentially zero, a result of the deterministic and highly predictable nature of digital filters. The main sources of error are normally the stability of the draft measurement entered by the operator (sensitivity to vessel motion), and a lesser contribution from the group delay of the transducer.

3) The **repeatability** errors contributed by the echosounder are difficult to measure, because under normal operating conditions they are dominated by instabilities in the propagation medium, which is of course outside the control of the echosounder.

3 DIGITIZED DEPTH VERSUS PRINTED ECHOGRAM

We are often asked about discrepancies between the digital depth value and the printed echogram. Most often, the printed echogram shows the leading edge of the bottom echo to be shallower than the digitized depth. This note addresses the reason for this apparent discrepancy.

In the early days of echosounders, before digitizers, the printed record was the only record. The hydrographer adjusted the draft and sound speed during a bar check using the depths he scaled directly from the printed record, based on his visual determination of the location of the leading edge of the echo. There were two problems with this approach. First, the hydrographer would have noticed that the depth was slightly dependent on receiver gain. By cranking up the gain he could "thicken" the bottom line and decrease the apparent depth slightly. Reducing the gain had the opposite effect. Second, the person who digitized the printed record back in the shop may have had a slightly different view of the precise location of the leading edge of the echo - a bias toward a lighter or darker shade of grey as the threshold point.

Both of these problems result from the fact that the leading edge of the echo is not a distinct event. The echo arrives as an increase in signal strength from the background noise level to the echo peak over a finite period of time. The rise time of the echo has a minimum duration of about half the transmitted pulse length. To put this into perspective, the duration of the leading edge of the echo from a 0.1 ms transmit pulse (a typical pulse length for high frequency shallow water work) is equivalent to almost 4 centimetres of depth. The longer pulses used in deeper water have longer rise times. In practice, however, the echosounder is more accurate than these rise times would lead us to believe.

In the days before digitizers, the easiest way to deal with the rise time problem was to operate the sounder with receive gain increased to the point where the background noise just started to show, and the bottom echo was strongly saturated. This has the effect of setting the detection threshold very low, almost at the noise level, and it works well because the human brain is very good at distinguishing echo from noise. The repeatability (and accuracy) of depths scaled by hand from such records is typically a fraction of the nominal pulse length.

The digitizer software, on the other hand, is designed to set its threshold at the midpoint of the leading edge, at the 50% amplitude point, because this is the value that provides optimum detection performance.

The problem is that hydrographers tend to set their visual threshold at the point in the echogram where the echo first becomes visible, which is often somewhat shallower. The difference between the digitized depth and what the hydrographer sees on the printed record is more pronounced at the high print contrast levels many users prefer, and with longer pulse lengths.

Two points are worth noting. First, the fact that the digitizer threshold is set at the 50% point rather than at some lower (but still visible on the echogram) value does not mean that the echosounder has a built-in error equal to half the rise time of the echo (or a quarter of the pulse length). In fact, the echosounder software accounts for this very precisely.

Second, the point at which the echo becomes visible on the echogram is highly dependent on the print contrast mode which is used (see the user manual for an explanation of these modes). With most print contrast modes (particularly including manual contrast), the relationship between the greyscale echogram and the digitized depth is subject to interpretation.

In summary, the digitized depth is most likely correct, even if the printed record appears to be slightly shallower. This should only be a matter for concern if the depth discrepancy is much greater than about a quarter of a pulse length.